



WELCOME ABOARD. Chairman and Chief Executive Officer Stanley C. Pace (right) and his successor, William A. Anders, officially joined forces this month when Anders started work at General Dynamics. Anders will serve as vice chairman in 1990 and will become chairman and chief executive officer when Pace retires at the end of the year.

TOM RULE

GENERAL DYNAMICS

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TIM WHITEHOUSE

As Convair produces Tomahawk cruise missiles at higher rates, thanks to winning 70 percent of production for fiscal year 1990, this overhead missile handling system helps free valuable floor space in production areas and ensures safe movement of missiles between workstations.

Convair captures 70 percent of cruise missile production

CONVAIR DIVISION'S DRIVE to compete effectively for annual production of Tomahawk cruise missiles paid off Dec. 14 when it won 70 percent, the maximum that can be awarded, of Navy cruise missile procurement for fiscal year 1990.

Convair's 70 percent award includes 10 percent of the missiles reserved for the producer with the highest quality.

The \$238 million contract specifies that Convair will make 280 Tomahawks. The remaining 120 will be manufactured by McDonnell Douglas. The two firms compete annually for cruise missile production under the government's dual-source procurement policy. Convair received 35 percent of the 1989 contract.

"Over the past several years our Tomahawk production team has worked very hard to find ways to reduce costs in an increasingly competitive defense business climate," said Convair General Manager John

McSweeney. "We've established new facilities, reduced material costs and introduced new standards in production performance, including factory modernization initiatives to improve productivity and quality."

Tomahawk has been Convair's major product line for over 15 years.

"This is very good news for Convair and the Tomahawk team, particularly in these days of tight defense spending and competitive procurements," McSweeney said. "Tomahawk is a high-priority program, and winning the major share of cruise missile production was very important."

Convair has delivered over 1,200 ground- and sea-launched Tomahawks. The ground-launched version has since been banned by the Intermediate Nuclear Forces Treaty. The government plans to acquire nearly 4,000 Tomahawks.

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News Briefs

South Korea picks F/A-18 over F-16 for future fighter

South Korea announced on Dec. 20 that it had selected the McDonnell Douglas F/A-18 Hornet over General Dynamics' F-16 Fighting Falcon as that country's new fighter aircraft.

The South Koreans will buy 12 aircraft from U.S. production lines and assemble or co-produce 108 others under foreign military sales and licensing agreements.

"We accept the Korean government's decision," General Dynamics said in a prepared statement. "It has been a long, hard-fought and close competition. We are disappointed that the F-16 was not selected, but we wish the Korean air force and McDonnell Douglas well with their program."

South Korea is already one of 15 nations that have purchased Fighting Falcons. General Dynamics delivered 36 F-16s to South Korea under an earlier agreement.

GD buys electrothermal firm

Land Systems Division has acquired GT Devices Inc. of Alexandria, Va., a technology firm engaged in electrothermal propulsion research.

The company will become a subsidiary of Land Systems. GT Devices' expertise in electrothermal propulsion, which enables cannons to fire their projectiles at higher speeds and longer distances than conventional guns, could be incorporated into M1A1 Abrams tanks manufactured at Land Systems.

Terms of the sale were not disclosed.

Employees pledge \$1.3 million

General Dynamics' employee Con-Trib Clubs in San Diego have pledged \$1.3 million to the United Way, the only million-dollar pledge in San Diego County during the United Way's recent annual campaign. The pledges, raised by the Electronics and the combined Convair, Data Systems-Western Center and Space Systems clubs, helped the drive total over \$27 million.

Brian Stevens chaired the Convair, Data Systems and Space Systems campaign and Walt Robertson headed the Electronics drive.

Services Co. 'adopts' kids

The domestic operations office at General Dynamics Services Co. made Christmas extra special for a group of youngsters at the St. Vincent's Home for Children in St. Louis.

Marlene Miller, financial assistant, Sue Kitchell, senior accounting assistant, and Mimi Wright, senior secretary, spearheaded the effort for their department to "adopt" the orphans for the holiday.

"We just wanted to do something for the community this Christmas," Miller said. "We decided to select a children's home and St. Vincent's was the closest to our office."

Each of the department employees chose two or three of the children and bought presents for them. Generic gifts also were purchased for the home and presented to St. Vincent's.

Electronics buying 58 acres

Electronics Division is purchasing 58 acres in Rancho Bernardo, Calif., just north of San Diego. The land will be used to consolidate operations now in leased facilities and for possible new business expansion. Terms of the pending acquisition were not disclosed.

Current & Comment

Wonder years

IF YOU THOUGHT the last decade was exciting (and who didn't), stick around. We can expect the '90s to be equally stimulating. For the company, the industry and the country.

The closing days of the '80s would have shattered anyone's crystal ball. Borders evaporating. Leninism taking its lumps. America's blue chips looking thinner and paler.

Predictably, "Euro-phoria" — and the resulting expectations of U.S. arms cuts — prompted banner headlines and sent aerospace/defense shareholders scurrying to the telephone with sell orders. But for those who have lived with the cyclical nature of our business, the reaction has been understandably less pronounced.

A reporter with a major metropolitan daily, discussing the potential downturn in the industry with GD Chairman Stanley C. Pace last month, observed, "You all appear to be quite calm about this."

"When you've been in these trenches for decades," Pace responded, "you accept the realities of the business. If you try to do things you don't know how to do — or if you do things at prices that are far too low, you blow yourself off the map."

"You don't stretch any program beyond its capability to be stretched. You fight as best you can to get what programs you can on a good financial basis. If you can't get a program on that basis, you pass it. Just kiss it goodbye. Long-term, the size of the sales is really secondary, in my view, to the effectiveness of the company, to the capabilities of your employees and your team."

That's a realistic business philosophy and it pretty much tells the story for GD today. The company has rigged itself for the heavy weather ahead. It's committed to its markets and its programs. There are no plans to build truck chassis or automatic bowling pinspotters, as Electric Boat Co. did — with little success — just after WWII. (The strategy of that move was about as apt as a company of that name building those products.)

When 58-year-old John Jay Hopkins fathered General Dynamics into existence from the parent Electric Boat back in postwar 1952, he said he wanted a company that would support many elements of American defense, and would also serve the economic needs of the United States and its allied nations. Hopkins died in 1957, but his vision was obvious.

Bill Anders, who will succeed Stan Pace as chairman (GD's sixth) and CEO at this time next year, is now on board as vice chairman. Bill was 18 — in his first year at the U.S. Naval Academy — when Hopkins incorporated this company. During the days that followed, in the military, with NASA and as an industry executive, Bill has worked with our people, flown GD-built aircraft and sat on industry panels with some of our top managers. And like many of our own, Bill calls San Diego his hometown.

We all welcome Bill to GD. We look forward to working with him in his current post and in his role as chairman in later years. The '90s will carry their own challenges, the most important of which for all of us is to continue doing the good job the customer has come to expect of us — and to do each job a little bit better with each passing month. While it's safe to say that the last decade of this century isn't beginning in the best of times, GD's capacity for performance and quality will stand us in good stead. ... PKC



Chairman and Chief Executive Officer Stanley C. Pace (left) and Corporate Human Resources Representative/Security Colleen J. Kohler (second from left) accept the Corporate Office's Cogswell award from Joseph R. DeGregorio and Diane McManus of the Defense Investigative Service.

Top security award won twice by GD

THE GENERAL DYNAMICS Corporate Office and Electric Boat's Quonset Point Facility were recently presented the Defense Investigative Service's highest award for sustained "excellence in the administration and performance of security duties and responsibilities" in separate ceremonies at St. Louis and Quonset Point, R.I.

The award, presented annually to only 70 of 12,500 DIS-cleared facilities in the United States, is named after James S. Cogswell, a late Defense Investigative Service chief whose administration in the mid-1960s set the principles that guide the Defense Industrial Security program today.

"Four General Dynamics facilities have won the coveted award in the last three years," said William I. Ferrier, corporate director-security. "You don't win the Cogswell Award if you have one inspection that just happens to go well. The team spirit and cooperative effort of the Corporate Office employees, and the

leadership of top management, resulted in nine consecutive no-deficiency ratings over a 4½-year period."

Corporate Office received its Cogswell from Southwestern Region Director of Industrial Security Joseph R. DeGregorio and Quonset Point received its award from Director of Industrial Security Alfred Buccigrosso of the New England Region.

"Companies would kill for this award, but in this case, it was won only because it was deserved," said DeGregorio at the St. Louis presentation.

Quonset Point has logged four consecutive no-deficiency ratings. "We have more than 4,000 employees, 200 acres, 57 buildings and five miles of perimeter fencing," said James R. Gulluscio, manager-plant protection at the Quonset Point Facility. "It's a team effort and we get excellent support from employees and management. The security department may set up the procedures, but it's the employees who do the work."

■ Chris Schildz

Community Service nominations due

NOMINATIONS ARE DUE JAN. 31 for the company's 1990 Community Service Awards.

The program recognizes an employee at each division and subsidiary who volunteers time and talent to educational, civic or community service organizations.

The awards include \$1,000 contributions from General Dynamics in the winners' names to the organizations for which they volunteer.

All full-time employees and anyone retiring in 1989 are eligible. Employees can nominate themselves or others.

Nominations should consist of basic personal information and supporting service documentation and should be submitted to local community relations managers. They can provide complete instructions for nominations.

The program is in its second year. Awards have been added in 1990 for Electric Boat's Quonset Point, Fort Worth's Abilene, and Pomona's Camden facilities.

The 1989 winners of the Community Service Award: Cessna — **Doug Wilson**, who has since transferred to Land Systems, for work with the Cessna United Friendship Fund, the United Way, and The Caring Place, a psychosocial community support group.

Corporate Office — **Roger Krone**, for work with the Soldan High School partnership program.

Convair — **Bob Giantvalley**, for work with the Peninsula Family YMCA.

Data Systems — **Kathleen Tucker**, for work with the San Diego Sheriff's Department.

Electric Boat — **Henry Nardone**, for work with the University of Rhode Island.

Electronics — **Donald Brown**, for work with the Elementary Institute of Science.

Fort Worth — **Ted Bruton**, for work with the Peaster, Texas, Volunteer Fire Department.

GD Services Co. — **Rick Seel**, for work with the

Southeastern Connecticut United Cerebral Palsy Association.

Land Systems — **Virgil Dickman**, for work with the Middlepoint, Ohio, volunteer fire department.

Pomona — **Sheryl Brown**, for work with the Chaffey-Ontario Special Olympics.

Space Systems — **Connie Zuniga** and **Nanc Anderson-Metz**, for work with the Salvation Army.

Valley Systems — **Sandy Doyle**, for work with the Inland Empire Section of the National Council of Negro Women, and **Jan Steven Snyder**, for work with the Trails-End District of the Old Baldy Council of the Boy Scouts of America.

Convair

(Continued from Page 1)

The Tomahawk contract award for 1990 will have no effect on Convair's employment. About 2,000 of Convair's 8,300 workers produce cruise missiles, which cost about \$1 million each.

December's announcement capped an impressive year for Convair's Tomahawk program:

- Monthly production reached an all-time high of 36 in October, a rate which will hold through February.
- Tomahawk successfully completed 16 flight tests out of 17.
- The 1,000th sea-launched cruise missile in the dual-source program was delivered to the Navy in March. The 1,000th Convair-produced Tomahawk was turned over to the Navy in June.

GD advertisement turns science robot into a celebrity

SEN. EDWARD KENNEDY RECENTLY invited an unusual guest to appear before the Senate Labor & Human Resources Committee. The guest has been creating quite a stir in educational institutions since publication of a General Dynamics advertisement.

Kennedy noticed one of the ads and decided to find out what all the commotion was about.

Thus, Tharogem I, a Gemini robot used by the Thames Science Center in New London, Conn., as an instructional aid in science, will come to the Senate committee. Tharogem will appear early in 1990 along with his entourage that includes computers and his "offspring," little robotic cars that are offshoots of Project RobotACTS, a program that uses robots to increase student interest in the sciences.

Electric Boat Division, across the Thames River in Groton, Conn., has been involved with the program since issuing a grant for the construction of Tharogem five years ago. General Dynamics' help in the program was first publicized in "Together," a collection of stories about employee and company involvement in the community.

"I asked General Dynamics if they would buy into the program," said Jane Holdsworth, director and chief executive officer of the center. "At the time, we needed help just to keep the staff going. General Dynamics' gift came at an extremely critical time for us. The staff was in place, eager to explore the possibility of marrying contemporary technology to the traditional physical science curriculum."

"I really believe the idea would not have taken off without that original gift from General Dynamics."

The RobotACTS teacher training and testing program at the middle and high school levels involves 21 cities in three states and has reached an estimated 8,000 children in the five years of the program.

However, since the General Dynamics ad on the program ran for the first time Sept. 26 in *The Wall Street Journal*, and subsequently appeared in publications such as *The Washington Post*, *Business Week*, *Time* and *U.S. News & World Report*, the program has mushroomed. Holdsworth predicts that over the next five years, some 250,000 youngsters will be reached by replicating the program through school districts and

the education community.

"The story of our developing partnership with General Dynamics attracted much interest in the science museum community as well as among representatives of other corporations," Holdsworth said.

Students get involved with Tharogem — an acronym for Thames Robot Gemini I — immediately in the classroom through the robot's on-board computer. Tharogem tells the students about his systems, sings to them and, depending on the age of his audience, even produces various sounds.

There are no dreary lectures or textbooks in this approach to learning and applying physical science through a cohesive series of demonstrations, experiments, electronics assembly, computer application and robot construction.

"It goes into what could be a yearlong science curriculum program," Holdsworth said. "Students go beyond traditional textbook lessons in light, sound waves, electricity, magnetism and mechanics and learn firsthand how physical phenomena are harnessed by electronics and computer technologies."

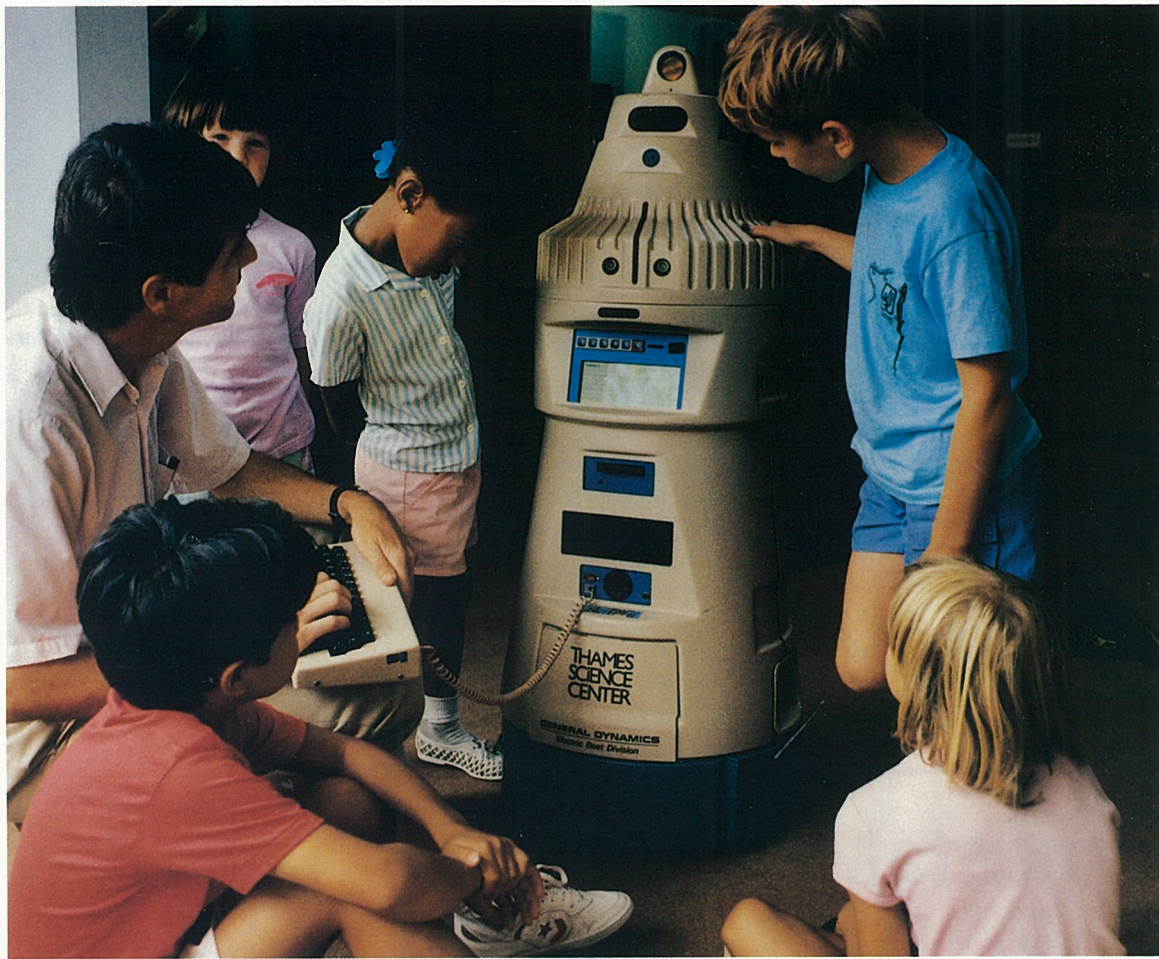
As the students progress through a series of demonstrations and experiments that reveal principles and concepts, they follow schematic diagrams to build computer-controlled robot cars. The robots are made of LEGO® specialty elements and controlled by Apple IIe software developed

by the Thames Science Center.

Kevin Bentley, a nuclear construction engineer at Electric Boat who donates time to the robotics program, has said it is exciting to see the kids get "turned on" by the program.

"I've read where the U.S. as a whole is losing its creative edge," he said. "Maybe a program like this will help get the younger generation involved with not only engineering and science, but with the entire technical field again."

■ Myron Holtzman



Tharogem I demonstrates its abilities to a group of students.

various museums.

"We are now developing a business plan that may enable us to replicate this program in 20 science museums throughout the country, serving 300 teachers annually over the next five years," Holdsworth said.

A highly regarded Washington video producer, reacting to the ad he saw in *The Washington Post*, has decided to include the project in a video on science education supported by the National Science Foundation, which should give the project higher visibility in



MAKING A POINT. Philip J. Stein, business planning specialist at Electric Boat, explains submarine-building techniques at the Groton, Conn., shipyard during one of the division's Midday Symposium Series. The series, which concluded in December, informed employees about business concerns. Electric Boat Vice President and General Manager James E. Turner Jr. (in pin-striped jacket at Stein's left) gave opening remarks.

Million Darlington bricks are bound for new Navy building

DARLINGTON BRICK & CLAY Products Co., a subsidiary of Marblehead Lime Co., will ship nearly a million bricks to the White House Communications Agency center. The facility is being built on a site selected by the Navy along the Anacostia River in Washington.

The five-story, 225,000-square-foot structure will use a combination of brown and light gray brick covering a two-story base and a five-story central tower. The \$25.4 million facility will support and maintain classified communications systems and equipment. Completion is scheduled in early 1991.

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Designing men

Land Systems tank developers recognized

A NATIONAL MAGAZINE RECENTLY published profiles of two Land Systems Division employees whom it called "the past and future of tank development."

The article, written by Alan P. Capps in *Defense & Diplomacy*, praised the contributions of Philip W. Lett and Gordon R. England to the development of the main battle tank.

Lett, formerly Land Systems vice president-research and engineering, is retired but serves as a consultant to the division. England succeeded Lett.

Lett "is a very quiet, unassuming man, who is obviously not given to boasting or bragging about his work, and who goes out of his way to make sure that credit is given where credit is due," the article said. "Yet Lett would have reason to boast, because he is considered generally to be the 'father of the M1 tank,' a tank considered by many to be the world's foremost."

"England holds the key to the next generation of main battle tanks. He brings with him skill, experience and devotion to systems integration that will ultimately emerge as the hallmark in the evolution of the next-generation M1 tank."

The M1 Abrams tank differed from others almost from the start. Its design emphasized survivability:

One of its safety features was a set of blast doors that separated the crew from the ammunition storage area. It incorporated a turbine engine that met with much skepticism. Engine contamination and track problems were corrected later. The result was a tank that has been highly praised and sought after by other countries; its first international users, Egypt and Saudi Arabia, will field M1s beginning in the mid-1990s.

The article said that "it is clear that Lett is proud of the M1 and of the people who worked with him on its design and production."

Capps wrote: "When asked about how it feels to walk out and see the M1 tank and know that he essentially designed it, he rejected the thesis that it was 'his' design. 'A lot of other people were involved,' he said. But that's the type of man he is, a quiet, skillful and powerful driving force who is not interested in any personal praise, with a mind that is as sharp as it was when he first became involved with tank design and whose overriding concern is giving the troops in the field the best equipment they could possibly receive."

England told the magazine, "We're doing some incredible things here, so exciting." Innovations that could be fielded on future tanks include stealth technology, electrothermal guns and new thermal sensors.



Gordon England (left) and Philip Lett are the driving forces behind the M1 Abrams tank, modeled behind them, and future tank designs.

"The key is combining that technology, and this is where England comes into his element," the story said.

England told the author that he does not share the pessimism of some industry managers about the United States losing its technological competitive edge. "Just look around here... at the average age of people working in some of the most advanced areas," England said. "They are young, and that's good for the company and country."

Drawing winner taken for a ride — in back seat of F-16

JOHN KITOWSKI'S GENEROSITY in supporting the United Way and other charitable causes recently earned him the ride of a lifetime, a flight in an F-16 Fighting Falcon.

Kitowski, a Fort Worth Division engineer who works in the advanced programs' operations research group, won the flight in a drawing held to cap the division's annual Con-Trib Club Campaign. The Employees' Con-Trib Club provides funds to the United Way, other service agencies and an emergency aid fund through payroll deduction.

All employees participating in the program at a certain level — called "Top Hand" contributors — were eligible to win the flight.

Kitowski flew in the rear seat of Fort Worth's technology demonstrator aircraft, F-16B No. 2, with company test pilot Bland Smith in the front. Smith made sure that Kitowski experienced a healthy dose of the Fighting Falcon's capability to accelerate and maneuver.

"We took off in maximum afterburner," Kitowski

said. "From the back seat, it was just like going into 'hyperspace' in the movie 'Star Wars.'"

Smith also gave him a chance to see how the aircraft handles and how the side-stick controller and electronic flight controls work. "The responsiveness was just unbelievable, compared to any other vehicle that I've ever operated," Kitowski said.

Kitowski controlled the airplane through a high-turn reaching 8.2 gs, and Smith later took him to the F-16's full 9-g turning limit. "The 9-g maneuver was by far the biggest thrill of the flight," Kitowski said.

Other maneuvers included loops, aileron rolls, a sampling of tactical profiles and traffic patterns.

Kitowski, a retired Air Force lieutenant colonel, is not a pilot. He is more familiar with the aircraft than the average person, however, because of projects he has worked on at Fort Worth including the Agile Falcon, F-16 Mid-Life Update and various new technologies for the F-16.

Some of the systems he has worked on were devel-

oped or demonstrated with F-16B No. 2, and Kitowski said he enjoyed the chance to see the capabilities in action.

Kitowski said the actual flight was only one part of the experience, which also included a flight physical, equipment fitting, cockpit familiarization, emergency egress training and a preflight briefing by Smith. "Everyone involved really made an effort to ensure that the flight was an enjoyable experience," Kitowski said.

Four other employees were offered simulator flights as winners in the Con-Trib drawing. The Con-Trib drive raised more than \$4.1 million in pledges, exceeding its goal by nearly \$70,000.

■ Joe Stout

▼ John Kitowski gets doused with the traditional bucket of water following his F-16 flight. Test pilot Bland Smith looks on. The christening is a ritual for first-time pilots and passengers in F-16s.



Modern maintenance systems boost efficiency

Psst. Hey buddy: Wanna save big bucks in your plant operating costs? Have I got a deal for you.

The "deal" at Pomona Division and Land Systems Division's Lima Army Tank Plant is a modern maintenance system. Using computer networks and other advances, Lima and Pomona have made their maintenance systems more efficient and saved a good deal of money. The accompanying stories detail how this was done (*stories by Dave Lange*).



Chuck Christman (left), Roxanne Clay and Mike Szekely introduce a new programming feature on the Maintenance Computer Network System at Land Systems' Lima Army Tank Plant.

Automation, centralization pay off at Lima

LAND SYSTEMS DIVISION'S Lima Army Tank Plant, where M1A1 tanks are assembled, has cashed in the winning ticket for a million-dollar payoff.

As the Lima, Ohio, facility strives to meet total quality management through continuous improvement, the plant has realized annual savings of more than \$1 million in maintenance costs. One aspect of that savings is the Maintenance Computer Network System.

The Maintenance Computer Network System centralizes and automates a variety of maintenance activities, such as inventorying property; tracking and charging work orders and labor; monitoring machines' lubrication consumption; and recording and dispatching maintenance trouble orders.

Land Systems officials credit the system with keeping Lima's equipment running 95 percent of the time, nine percent above average. "There's no other system like it," said Tom Brown, Land Systems manager-facilities.

Chuck Christman, a Lima senior project engineer, and Mike Szekely, Lima chief-preventive maintenance, "deserve all the credit for setting up the system," according to Roger Martin, Land Systems director-facilities. Christman and Szekely organized the operation in answer to a government request. They acquired off-the-shelf personal computer equipment so the system could use a universal computer language and could be easily updated.

The system features a data base linking the general foreman, tool room, facilities engineering, service garage, pipe shop, power house, armor room and various maintenance personnel in a 19-station network that can also communicate outside the plant. System users can retrieve the diagnostic data, maintenance history and associated costs of any equipment. Such information can be used for floor repair, cost justification, manpower planning and trend analysis. Having this data available at remote stations reduces the percentage of time maintenance workers used to spend manually obtaining the information.

Plans for the system include potential expansion into other departments at Lima that work with facilities and maintenance personnel. Lima will also begin a program that will move the facility from preventive maintenance to predictive maintenance. Predictive maintenance statistically analyzes machine operation to tell when equipment will fail, enabling personnel to replace parts shortly before they are predicted to break down.

One of the system's most important future benefits, incorporating the features of shop floor control, will enable preventive maintenance to be scheduled based on hours of use rather than by calendar date.

Lima's Maintenance Computer Network System is a pilot program that may be adopted by other Land Systems facilities.

Artificial intelligence is Pomona's 'expert'

ARTIFICIAL INTELLIGENCE HAS entered the realm of plant maintenance at Pomona Division.

American industry is applying artificial intelligence, perhaps best described as a computer system that mimics basic human thinking, to diverse activities. Pomona's maintenance engineers figured artificial intelligence could keep the division's equipment running and pay for itself five times over in annual maintenance costs.

The heart of Pomona's artificial intelligence maintenance is an expert system: a computer system that is programmed with the knowledge of human experts. The system deals with a problem by reproducing the human experts' rules of thumb and problem-solving skills. Some of the benefits of the system are that its expertise is always available; it states the limitation of its knowledge and the uncertainty of its conclusions; it benefits from the experience of many experts and applies its knowledge without bias; it considers all possible alternatives; and can be continuously updated.

The system enables computers to help Pomona's maintenance personnel analyze and resolve complex problems that can often be stated only verbally. Computer power is extended beyond mathematical and statistical functions to "talk" to the maintenance staff and use logic to suggest alternatives.

Pomona has three expert systems in place that augment human intelligence in repetitive procedures and in technical maintenance diagnostics of complex, critical equipment. The three systems share a maintenance information central data base. They not only use existing information in the data base, but download new information from applications of the systems back to the data base to ensure continual updating.

One expert system, the Maintenance Planning and Scheduling Adviser, automates the reporting of and response to equipment breakdowns. Anyone calling in a breakdown is asked for basic information that is fed to the expert system, which then either suggests a solution, refers the caller to a support group, or requests and schedules a work order.

Another system, the Maintenance Diagnostic Assistant, provides detailed technical troubleshooting for more than 100 pieces of equipment at the job site. Anyone inserting the proper diskette into the expert system will be guided through a variety of technical questions and measurements. The system will display on a computer screen any necessary alignment, will store such information, and provide printouts that become part of the machine history files required by government agencies.

The third system, the Energy Management Assistant, monitors temperature sensors and other indicators and automatically makes adjustments formerly done by an operating engineer. The system sends out a work order for adjustments it can't do.

The three systems are tied to the central data base through a link called Maintenance Information Network Knowledge. Production operators and maintenance craft employees will use the link, which is in its early development stages, for "expert" assistance. Pomona expects this assistance to reduce maintenance costs by more than 20 percent.



Charlene Emerson, a facility control clerk, taps into Pomona's artificial intelligence maintenance system.

GD hazardous waste managers share research

CONVAIR DIVISION recently sponsored a unique conference for all divisions to share the results of their work in environmental resource management.

"This is the first time we have had a real technical get-together of materials and process engineers, manufacturing technology, safety and health, and environmental resource people to look at our future together," said Gerry Hardacre, Convair's environmental resources manager and conference host.

Those who attended are working toward the company's goal of zero discharge of hazardous waste. Fort Worth will hold the 1990 conference.

The conference began with information on surface coatings used at various divisions. Conferees discussed different application methods and strategies for controlling emissions.

Attendees also focused on the preparation of metal surfaces with alternative cleaning methods and substances developed and tested by the divisions. Of particular interest was a presentation by Earl Turns, project engineer-environmental resource management research and engineering at Fort Worth, who showed the work being done there on soap solutions to replace degreasers.

Other presentations included futuristic nonchemical cleaning methods such as carbon dioxide ice crystals, ultrasonics and supercritical fluids.

The conference also included an update on the work of the California Regulatory Affairs Coordinating Council by Chairman Al Skiles from Convair. Representatives from each of the California divisions review legislation and regulatory proposals to ensure that they

maintain the environmental and economic balance for the company to remain competitive. This year the committee tracked 43 bills in the California legislature.

The most significant findings of the conference:

- Chlorofluorocarbons, used as solvents and cleaners in manufacturing as well as in air conditioning systems, have been linked to destruction of the earth's ozone layer. The company is committed to eliminate chlorofluorocarbons from its production processes. All divisions have active research programs to find acceptable substitutes for chlorofluorocarbons or to totally

eliminate the need for them.

- Chrome solutions have been used for corrosion control. Extensive research into non-chromic chemistry continues throughout the company, but the divisions will not stop at merely replacing old chemicals with new substitutes that may also have an environmental impact.
- All divisions generally have any new system reviewed by manufacturing technology, safety and health and environmental resource management before it is introduced into the operation.

■ Julie Andrews

Navy praises Pomona's pollution controls

POMONA DIVISION AND ITS Naval Plant Representative Office were recently commended for outstanding environmental protection efforts by Secretary of the Navy H. Lawrence Garrett III.

In a letter to the office's commanding officer, Capt. Richard W. Gilbert, Garrett cited the facility's recycling, recovery and equipment upgrade programs that have nearly eliminated the discharge of pollutants.

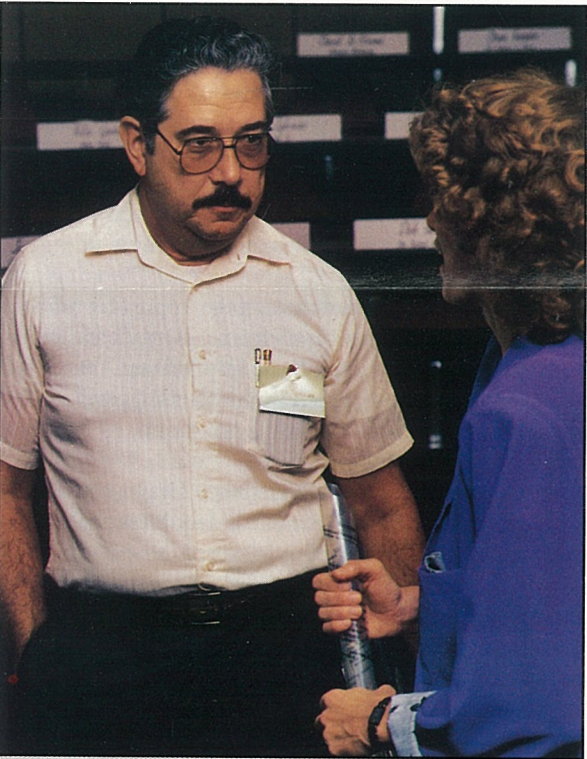
Garrett noted that the various awards the division has received for clean air, hazardous waste management and innovative pollution control technology have made

Pomona's Navy-owned facility a "leader in the highly critical California environmental arena."

"Your efforts are unequaled elsewhere in the Navy," Garrett wrote. He praised the facility's environmental management program as reflecting "the highest commitment and professionalism in a modern Navy that is determined to improve the quality of the land and sea."

Gilbert said the recognition is a direct result of cooperation between the division as a contractor and the Navy as a customer and landlord for the facility.

■ Eric Solander



SCHOLARSHIP WINNER. Carlos Iglesias, president and owner of a company that supplies precision tool parts and accessories to Valley Systems Division, listens to Associate Professor of Business Administration Susan Ashford after a class in organizational behavior at Dartmouth College. Iglesias received a General Dynamics scholarship to attend the Minority Business Executive Program at the Amos Tuck School of Business Administration at Dartmouth. The program enables minority entrepreneurs to strengthen their management and financial skills.

Quonset Point center promotes literacy

The Quonset Point (R.I.) Facility of Electric Boat Division is establishing the state's first full-fledged company-based learning center specifically devoted to reading skills.

The center will feature eight Unisys computer stations and software specifically designed to teach reading from the fundamental through high school levels or to begin at any level in between.

The Quonset Point Facility will use the center, which will be housed in a special classroom adjacent to the facility's employment office, to provide reading instruction to any employee with reading difficulties. The center is under construction and is expected to be ready by Feb. 1.

The \$117,000 project is being funded in part by a \$44,800 grant from Rhode Island.

"There is no doubt that reading problems have a real impact on any company's ability to do business," said William W. Bennett, Quonset Point vice president and general manager. "We believe we have an obligation, both to our company and particularly to our employees, to ensure that the men and women

who are part of our team have the reading skills they need to function effectively on the job so that they may succeed in their careers and fulfill their potential."

The center will operate initially four hours per day under a coordinator hired especially for the program. The center will also use individual reading volunteers to offer one-on-one instruction.

The Unisys system was chosen for the possibilities offered by the system's hardware and instruction software. As many as 32 computer workstations can feed into one central processing unit. While the workstations feature color monitors, sound and full computer keyboards, program participants need only use a track ball and a single key to operate the reading software.

"While there is certainly a practical payback for the facility in becoming involved in literacy, I sincerely believe that the best payback of all will be the tremendous sense of satisfaction and pride that will be felt by those who come into this program, starting from scratch, and make real progress in learning to read," Bennett said.

■ Dick Boudreau

Valley Systems boosts employee careers

FOUR VALLEY SYSTEMS EMPLOYEES have been selected for the division's two-year career enhancement program.

The program, which began in 1988, identifies and grooms promising minorities and women to broaden their careers.

The new participants are Melissa K. Cooley, electronics engineer; Lori L. Lehman, estimating specialist; Frank F. Delgado Jr., quality engineer; and Martin D. Howell, design engineer.

Although their individual schedules for the next two years will vary, all of the participants will spend time gaining additional information about their own departments as well as departments with which they work.

For example, some of the participants will be working in engineering, procurement quality assurance, material control and contracts.

The assignments are determined by a management committee with the assistance of the individual program participants.

Cooley joined Valley Systems in 1986 as a laboratory electronics technician and earned her bachelor's degree in engineering technology from California State Polytechnic University-Pomona.

Cooley said she was "ecstatic and very happy" when she learned of her selection. She expects "to learn more about the company and other departments at the divi-

sion, get new ideas and make contacts" with fellow employees during her two-year stint.

Lehman joined the division in 1986 as an estimator and earned her bachelor's degree in business from California State University-Fullerton. Lehman said she sees the program as "a wonderful opportunity."

Delgado started with General Dynamics at Pomona in 1979 as a tool crib attendant in the machine shop. He transferred to Valley Systems and is taking classes in business management at California State University-San Bernardino.

Delgado said he felt privileged to have been chosen for the program. He added that his selection will give him good exposure within the division and "will make me a good candidate for a managerial position. I'm looking forward to starting the program."

Howell joined Valley Systems in 1985 as an associate design engineer. He earned his bachelor's degree in mechanical engineering from the University of California-Berkeley. He said his selection is "an opportunity to broaden my experience outside of the design area and to enhance my future here."

Five other employees, Anita F. Evans, Bridget A. Gomez, Colleen M. Hope, Vicki E. Pennisi and Beth Wahl, are in their second year in the program.

Jeannie Radney is administrator of the career enhancement program.

■ Jerry Littman

Savings and Stock Investment Plans

	Annual Rate of Return for the 12 Month Period Ending:		
	Nov. 1987	Nov. 1988	Nov. 1989
Salaried			
Government Bonds	5.6%	7.1%	9.9%
Diversified Portfolio	(2.7)%	21.7%	33.5%
Fixed Income	11.5%	10.7%	10.3%
Hourly			
Government Bonds	5.7%	7.3%	10.1%
Diversified Portfolio	(2.2)%	22.0%	34.4%
Fixed Income	11.5%	10.7%	10.4%
GD Stock Closing Price	\$43.25	\$50.50	\$43.62

() Denotes Negative Number



Soviet test pilot Valery Menitsky inspects an F-16 cockpit in Fort Worth. With him (from left) are Fort Worth's Kevin Dwyer; Apollon Systsov, minister of the Soviet Union's government aviation industry; and Aleksandr Velovich of the Mikoyan Design Bureau.

Texas hospitality meets Soviet *glasnost* during tour of Fort Worth's facilities

FORT WORTH DIVISION PLAYED a small part in the growing flow of East-West communications recently when six of the Soviet Union's senior aircraft designers toured the F-16 production line during a U.S. government-approved visit.

The visitors were Apollon S. Systsov, minister of the USSR's government aviation industry; German I. Zagainov of the Central Aero/Hydrodynamics Institute; Rostislav A. Belyakov of the Mikoyan Design Bureau, which produces the MiG series of fighters; Valery Y. Menitsky, chief test pilot for Mikoyan; Aleksandr V. Velovich, also of Mikoyan; and Pyotr V. Balabuyev of the Antonov Design Bureau, which produces the An-225, the world's largest transport aircraft.

The visitors spent several weeks in the United States under an academic and industry exchange program. They received unclassified briefings and viewed a completed F-16 while in Fort Worth.

The Soviets, in turn, gave presentations on the

history of MiG production and flight testing to a group of Fort Worth engineers.

Liza Wimberley, a Fort Worth engineer who emigrated from the USSR with her family many years ago, served as the company's interpreter. "They were very friendly and they seemed sensitive to our possible security concerns," she said. "I thought they seemed careful not to ask about anything we might not want to tell them, but at the same time they were very open about their own facilities."

"They were especially impressed with the availability of computers at our plant. I don't think they'd ever seen anything like it."

The Soviets' visit included a tour of the city and an evening of western entertainment at a nearby cattle ranch.

A U.S. delegation will make a reciprocal visit to comparable Soviet facilities this spring. ■ Joe Stout

New F-16 support equipment passes test

A TWO-YEAR COMPANY-FUNDED effort to develop a mobile tester for F-16 avionics units recently concluded successfully at Nellis Air Force Base, Nev.

With representatives from the Air Force's F-16 Systems Program Office and Tactical Air Command Headquarters looking on, maintenance shop personnel from the 57th Component Repair Squadron performed tests on three of the F-16's most complex line replaceable units, proving the General Dynamics concept that complex avionics can be tested by mobile support equipment. An Electronics-Fort Worth engineering team developed the tester.

Electronics has been building automatic test equipment for F-16 avionics since 1976 in a configuration known as Avionics Intermediate Shop. The shop consists of four stations that test the F-16's avionics.

Recognizing the Air Force's need for mobile avionics support equipment, the company funded development of the next generation of the F-16 equipment. Two years ago, Electronics and Fort Worth decided to join forces and consolidate independent research and development programs for mobile support units.

The objective of the team was to provide the Air Force with quality, cost-effective avionics support

equipment to meet future needs. The mobile tester can support an aircraft that may have to land in the middle of nowhere during a wartime scenario.

The Electronics/Fort Worth team examined goals from several Air Force quality initiatives, and met with maintenance shop personnel at U.S. air bases around the world to present their design concepts and get feedback.

An initial demonstration using a mock-up at Nellis in January 1989 provided additional feedback on mechanical design and human factors. The operational unit was designed and built in San Diego and integrated with the test software at Fort Worth, culminating with the successful proof-of-concept demonstration at Nellis. After the first day's successful trials, the tester was operated at the flight line powered only by a mobile generator on the second day.

"The demonstration was a complete success," said Mel Barlow, vice president and Electronics general manager. "But it could not have been completed by either division alone. This team project has resulted in a more efficient and operationally flexible support system for the U.S. Air Force. We believe this will lead to a full-scale development program for Fort Worth and Electronics." ■ Julie Andrews

Fort Worth supplied food, money, expertise to community in 1989

FORT WORTH ENDED THE '80s and set the tone for the '90s by supporting a variety of community efforts in the final weeks of last year.

Employees donated more than 28,000 pounds of canned goods in the annual drive benefiting the Food Bank of Greater Tarrant County. The total exceeded the drive's goal of 25,000 pounds and easily surpassed the 16,000 pounds of food collected in 1988.

More than 100 employee volunteers helped collect the food. This year's drive was supported by all of Fort Worth's labor unions and their members.

In another major holiday season effort, the Adopt-A-Family program, individual work groups "adopted" 177 needy families. Employees purchased food, clothing, toys and other items to make the holidays happier for families identified by area service agencies. The program is coordinated by Fort Worth's National Management Association chapter.

These events followed a fall program in which the company saluted outstanding students in the local school district by providing 198 academic letter sweaters to those who maintained a grade-point average of 3.8 or better in their sophomore year. The \$7,000 worth of sweaters were presented to the high school juniors by Fort Worth Vice President and General Manager Charles A. Anderson and school district officials.

Fort Worth also supported the annual Math and Science Teacher Symposium in association with the Fort Worth and Metroplex Alliances for Engineering Education. More than 60 teachers from Texas school districts received a better insight into the practical application of their subjects.

Groups of employees also participated in several other activities in the year's fourth quarter, including the Cystic Fibrosis Sports Challenge, which raised \$8,000; the annual Turkey Walk, benefiting the American Heart Association; and a Multiple Sclerosis Association "haunted house" that raised \$60,000. ■ Joe Stout

Minority educators pitch research ability to California divisions

REPRESENTATIVES FROM EIGHT black colleges and universities attended a recent conference held by Electronics Division to exchange information on the research capabilities of their institutions with the technology leaders in General Dynamics' California divisions.

Attendees included Florida A&M State University, Hampton University, Howard University, North Carolina A&T State University, Prairie View A&M University, Southern University, Tennessee State University and the University of the District of Columbia. General Dynamics divisions included Space Systems, Convair, Pomona and Valley Systems as well as Electronics.

The result was an increased research contract between Electronics Division and North Carolina A&T that went from \$14,000 to \$64,000. Florida A&M is scheduled to receive a \$20,000 contract, and Grambling, not represented at the seminar, will get a \$30,000 contract.

It was a getting-to-know-you conference. Representatives presented overviews of their schools during the first day of the conference. General Dynamics scientists and engineers gave division overviews on the second and last day.

"The technical exchange meeting was an excellent means for the General Dynamics people to understand the scope of the research being conducted at these universities," said Boyd A. Christensen Jr., vice president of research and engineering at Electronics. "Great credit is due to Betty Fleming of our small business department and Rudy Rodolfo from our independent research and development area for organizing the meeting."

Speaking for all the schools, Dolores R. Spikes, president of Southern University Systems and university chancellor, said: "We want a long-standing partnership with General Dynamics. We feel we can deliver, and we can be of mutual benefit to your company."

EDUCATION

STRATEGY FOR THE LONG TERM

ONE OF THE MOST IMPORTANT long-term strategies that American business can pursue today is support of our national educational system. The wide range of sophisticated products designed and built in this country depends on intelligent, well-schooled employees. Without them, America stands in great risk of surrendering its world leadership role in technology.

The long-term implications for the nation are even greater. As President Lyndon Johnson said, "The answer for all our national problems — the answer for all the problems of the world — comes to a single word. That word is 'education.'"

Money is the obvious means for us to support education. But other, more subtle methods are equally effective. The list is long but it includes:

- Working with school officials to help reform curricula;
- Making management training available to school officials;
- Offering company facilities to educators for strategy sessions;
- Providing forums for school officials to express their views;
- Establishing homework hotlines and organizing other student assistance programs using company personnel and resources.

Our divisions and subsidiaries have already established many excellent partnerships with educators. But it is important that we do even more. The well-being, the values and the security of future generations depend on it.

SPace

Stanley C. Pace
Chairman and Chief Executive Officer

Division/subsidiary education programs

Just a few of some of the education programs under way at various General Dynamics locations:

Location	Program	Description
Corporate Office	Access to Success	Provides mathematics and science activities for sixth, seventh and eighth graders in three St. Louis school districts in partnership with the University of Missouri-St. Louis.
Convair	Industry fellow	High school and community college teachers team with private industry on short-term projects to increase their knowledge of job demands and emerging technologies.
Data Systems-HQ	Regional Consortium for Education and Technology	Opens company's Personal Effectiveness Program seminars to St. Louis teachers and helps educators plan for better access to high technology.
Data Systems-Eastern Center	Adopt-A-School	Contributed money for computer integrated manufacturing lab and provides employees for advisory boards at Thames Valley State Technical College; recently expanded to Eastern Connecticut State University.
Data Systems-Central Center	Adopt-A-School	Wrote curriculum and provided teachers for McLean Middle School Computer Club; tutors "last-chance" students for skills tests; provides speakers; donates computer equipment.
Data Systems-Western Center	Adopt-A-School	Taught parliamentary procedures and public speaking; sponsored Junior Achievement business classes; provided journalism, fine arts, speech, mathematics and science awards. For sixth, seventh and eighth graders at Gaspar Deportola Middle School.
Electric Boat	Tank project	Helps drafting and shipbuilding students at Ella Grasso Southeastern Regional Vocational Technical School to design and build structures.
Electric Boat-Quonset Point	Adopt-A-School	Provides teacher grants, scholarships, printing services, repairs and shop tools to Cranston (R.I.) High School East.
Fort Worth	Math/science	Holds workshop for middle and high school teachers that relates math and science to business world; publishes material that links textbook principles to F-16 construction.
Land Systems	Junior Achievement	Employee volunteers help students and teachers with business exercises and attend class sessions weekly.
Pomona	Vocational Industrial Clubs of America	Contributes surplus material, \$8,000 annually and employees as committee members and contest judges.
Pomona-Camden	Industry and Education Cooperation	Established Graduate Resident Center for Engineering and provides programs in general equivalency diplomas and undergraduate and graduate degrees at Southern Arkansas University Tech.
Space Systems	NMA School Partnership	Conducted science fair; contributed \$2,000; provided classroom speakers; formed Young Astronauts Club; arranged tour of General Dynamics Vandenberg Facility; and donated promotional materials, all at Knox Elementary School.

New program gives teachers project funding

THE START OF THE NEW decade marks the beginning of a new education program at General Dynamics called Teaching Excellence Grants.

The grants are cash awards up to \$1,000 for projects proposed by elementary and secondary school teachers located in school districts invited to participate by GD and/or its divisions or subsidiaries. The projects can be for classroom or laboratory materials, teaching aids or field trips.

Each company location can give up to five grants annually that total \$1,000. No award will be less than \$200. Teachers from eligible school districts who submit proposals to their local General Dynamics community relations manager will be considered for grants in 1990.

Committees at each division and subsidiary will review proposals and select 1990 winners. Teachers who receive grants are required to turn in a final report after their projects end. Those who submit final reports will receive \$100 honoraria.

"Schools may not always have enough resources to take their students' education beyond ordinary classroom experience, material or equipment," said Bill Pedace, corporate director-community relations. "Teaching Excellence Grants has been developed to provide classroom or lab materials, teaching aids or field trips for which funds are not otherwise available."

Teachers interested in seeking grants should obtain application guidelines from their local General Dynamics community relations manager or call Pedace, (314) 889-8442. Proposals will be judged on creativity, practicality and feasibility; clarity and suitability of objectives; and application and transfer to other educational settings.

o o o

Children's education involves parents, too

GENERAL DYNAMICS employees who are parents have an important role to play in education. "The things we do at home and our own attitudes about school have a major influence on children's academic and personal growth — at all ages."

So writes Robert E. Bartman, the Missouri commissioner of education, in "How To Get Involved in Your Child's Education," a pamphlet available from the Missouri Department of Elementary and Secondary Education and published in cooperation with Southwestern Bell Telephone.

The booklet provides five checklists for students' parents. A few tips from the pamphlet:

- Don't wait until the 12th grade to start thinking about your child's goals and interests.
- Take advantage of preschool screening programs offered by most school districts.
- Review your child's daily schoolwork and homework assignments.
- Organize household schedules and responsibilities.
- Don't criticize teachers or school officials in front of your children.
- Cooperate fully with teachers and maintain as positive a relationship as possible.

The free pamphlet is available by writing Public Information Office, Missouri Department of Elementary and Secondary Education, P.O. Box 480, Jefferson City, MO 65102.

Dear Employees:

On January 16 1990, David Sirota (of Sirota, Alper and Pfau) spent the day reviewing and discussing the results of our second Survey of Employees with the corporate officers and general managers. As we listened to the corporatwide results, we were pleased to see that some of our actions taken after the 1986 survey have made a difference. We were also disappointed that our actions did not resolve other concerns. We clearly heard your message that there are some challenges ahead.

In our discussions, it was apparent that it would be impractical to set action plans at the corporate level on each of the concerns. Therefore, the executive team helped me to identify five corporatwide issues for which I will accept the leadership role. These five are:

- Give attention and priority to our hourly employees' concerns.
- Re-examine the reward system for all employees (recognition, performance feedback, appraisal, pay).
- Define our leadership expectations for our supervisors and managers.
- Assure that our TQM program identifies and implements specific projects that resolve employee concerns about in-process quality.
- Acknowledge and continue to address the concerns of our employees regarding the use/abuse of drugs and alcohol in the workplace.

I will be assessing, with the executive team's help, what action is necessary to further define each concern and to determine actions that will most effectively and efficiently improve the situation. I will be communicating to you through letters and news articles as we proceed.

During this period, each general manager and the other supervision in the company are receiving feedback from the survey with regard to their people. Each are selecting five or so issues that most concern you and your fellow employees. As I have, they will be assuming personal responsibility for the action on these matters and for keeping you informed of their progress.

We are pleased with the participation the survey received and your willingness to share your opinions and comments. I invite you to continue your involvement by being a part of the process of our continuous improvement.

Sincerely,

Stanley C. Pace

Stanley C. Pace

Special Report: 1989 Survey of Employees

THE SURVEY OF EMPLOYEES is a major contributor to the goal of continuously improving our company operations. Therefore it is important that we are all aware of the results of the recent survey.

The development of the survey, the results of which are presented here, began with General Dynamics employees themselves. As noted in an earlier edition of *General Dynamics World*, the survey questionnaire was developed from input of employees throughout the corporation. A task force of division survey managers conducted a total of 85 focus groups. Management and union reviews were held at all divisions.

The task force analyzed the input from all meetings and developed a set of 75 questions, covering the key points. These 75 questions became the "core" items asked at all divisions during survey administration from Oct. 3-Nov. 10, 1989. In addition, the task force assisted each division in identifying additional topics to include in the division's survey. Some divisions added up to 25 questions to address division-specific concerns.

During November and December, the results were read by computers and analyzed by the consulting firm of Sirota, Alper and Pfau. This is the same organization that assisted with our first survey in 1986. The consultants noted that considering the size of General Dynamics, they are impressed with everyone's commitment to action. In particular, employees showed strong interest in giving their ideas by using the write-in questions. Responses on these items showed a high level of seriousness and dedication.

Participation in the survey was voluntary, with over 58,000 employees taking the time to complete the questionnaire. This represents a response rate of approximately 70%, almost identical to our participation rate in 1986.

This publication contains information on all 75 of the corporatwide questions; these are the questions that were asked at all divisions. Most of the information is displayed in graphs. The data shows the "total" for the General Dynamics population, along with major occupation groups (hourly, non-exempt, exempt non-management and management). Some charts also give the 1986 response rates for the "total" population. The

accompanying text adds background and analysis of key items.

Results for your division will be distributed in the next few weeks. Due to involvement in a parallel survey-type program, employees at the Groton site of Electric Boat are not represented in this data. They will receive periodic status of their location's change program via site-newsletters.

General Dynamics Employees Responding to Survey

Classification of Employee	Number
Hourly Employees	21,183
Non-exempt Employees (management support personnel)	5,984
Exempt Employees (non-managers such as engineers and staff)	22,063
Management Employees	6,964
Unidentified Employees	1,897
Total Employees	58,091

SEX: Demographic information indicates that 75% of General Dynamics employees who took the survey are male and 25% are female. Women are most heavily represented in the non-exempt group (58%), while men are represented strongly in the management group (91%).

RACE: Of the employees who took the survey, 85% are white. Of the remaining 15%, 5% are Black and 5% Hispanic, with 3% Asian and 2% Native American. This profile is similar to that of the 1986 participant population.

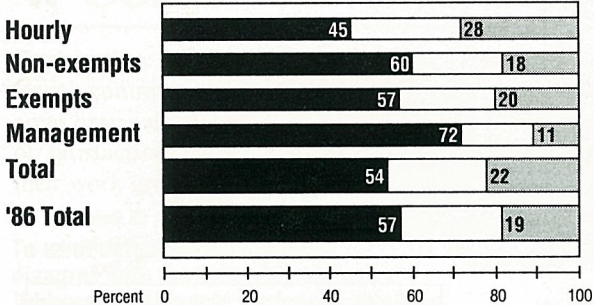
TENURE: There is wide diversity in length of service of employees. About half of those responding to the survey note they have worked for General Dynamics between 3 and 10 years. Eight percent have been with the company less than one year, while 11% have been employees for more than 20 years.

1. Overall Satisfaction

Explanation: In this section, employees were asked to rate their overall satisfaction in working for their division and with their job itself. They also rated the extent to which they enjoy coming to work. All things considered, responses to these questions provide an overall measure of employee satisfaction and morale. Specific factors that contribute to these general feelings will be detailed in later sections.

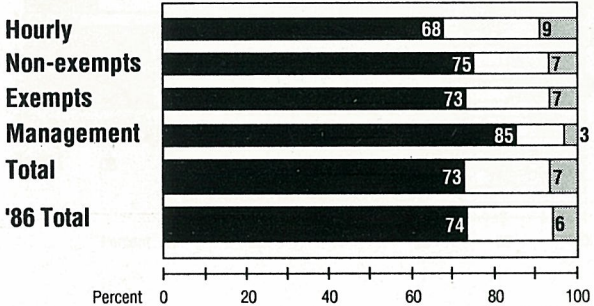
Considering everything, how would you rate your overall satisfaction as an employee at (your division)?

- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied



How would you rate your satisfaction with the job itself — the kind of work you do?

- Good
- So-So
- Poor

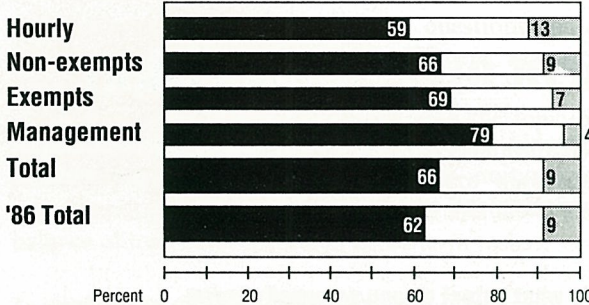


One important element of employee satisfaction is pride. People want to feel proud of their company, the products and services they contribute to, and their working conditions. Pride is discussed in this section since it is so closely related to overall satisfaction.

It should be noted that the total ratings reflect the collective responses of all employees across the company. Ratings for individual divisions may vary from these corporatwide results.

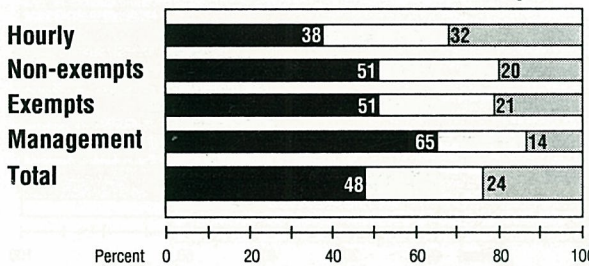
To what extent do you agree or disagree: I feel proud to work for General Dynamics.

- Agree
- Neither agree nor disagree
- Disagree



To what extent do you agree or disagree: I enjoy coming to work.

- Agree
- Neither agree nor disagree
- Disagree



Analysis: The survey results show a moderate level of overall satisfaction among General Dynamics employees. The level of satisfaction (54% favorable) is similar to the 1986 ratings, although there is a slight decline in satisfaction among hourly employees.

As is common in employee surveys, management is the most favorable of all groups. Non-management groups (exempt, non-exempt, and hourly) report similar levels of satisfaction. But hourly employees are somewhat less satisfied than exempt and non-exempt employees.

Ratings of job satisfaction are significantly higher, with a similar pattern of response to the overall satisfaction question. Management is highly positive (85%). Other employee groups are also positive, but less strongly. In addition, there is little change in any group from the 1986 results.

Sixty-six percent of all employees are proud to work for General Dynamics. Compared to 1986, the sense of pride increased for all groups, except hourly employees whose ratings remained nearly identical.

One-half to two-thirds of management, exempt, and non-exempt employees say they enjoy coming to work. Hourly employees are somewhat less favorable (38%).

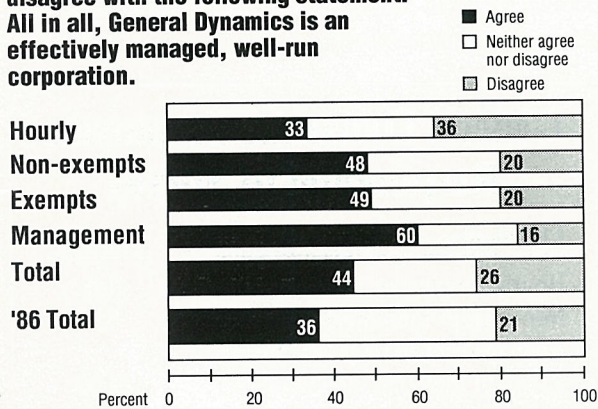
In summary, the survey shows that all employee groups rate satisfaction with their job and with the company positively. Across questions, management employees are consistently more positive than the other employee groups. Most employees are proud to work for General Dynamics, but one in three hourly employees reports not enjoying coming to work. Salaried employees feel more pride in working for General Dynamics today than they did in 1986. Among hourly employees, there is little change; however, they report a slight decline in overall satisfaction.

2. Performance of Organization

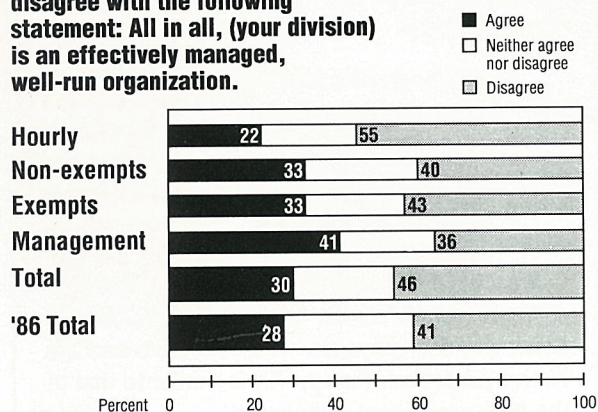
Explanation: This section deals with how employees view the performance of General Dynamics and their division. Employees were asked if the corporation and their specific division are effectively managed, well-run organizations.

In addition to general performance, questions were asked about specific division qualities: efficiency, planning, cooperation, and final and in-process quality.

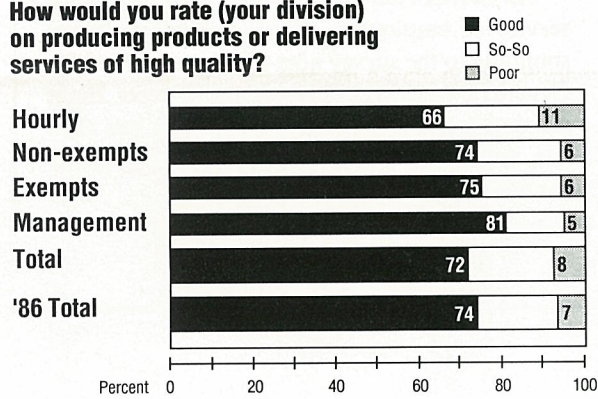
To what extent do you agree or disagree with the following statement: All in all, General Dynamics is an effectively managed, well-run corporation.



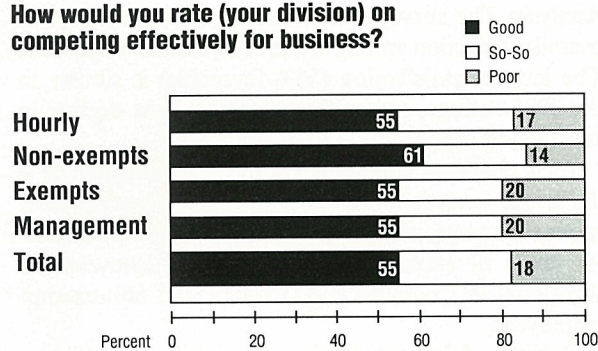
To what extent do you agree or disagree with the following statement: All in all, (your division) is an effectively managed, well-run organization.



How would you rate (your division) on producing products or delivering services of high quality?



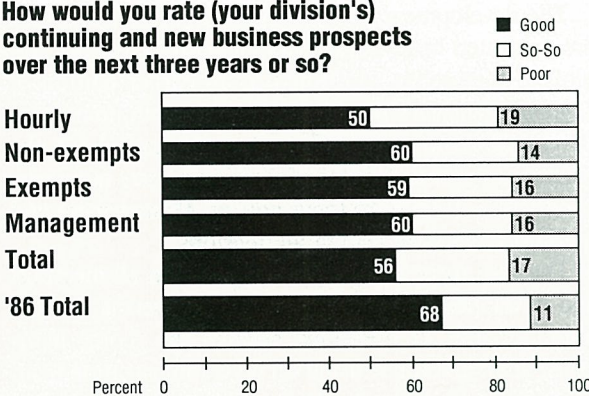
How would you rate (your division) on competing effectively for business?



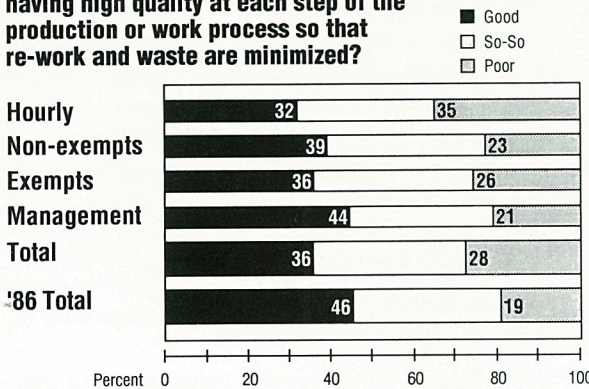
Also, the division's ability to compete and its near-term business prospects were addressed.

These questions provide information concerning the effectiveness with which work is organized and accomplished. People want to work for an organization that they feel performs well. This contributes in turn to overall levels of employee satisfaction and pride.

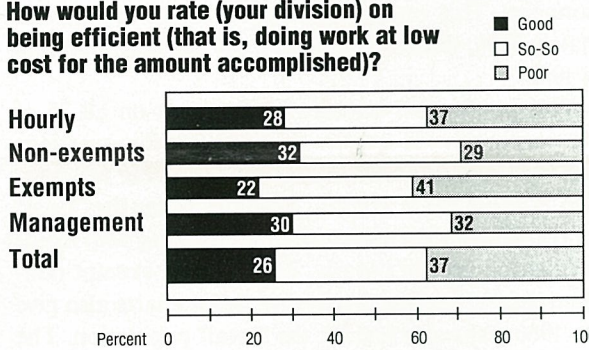
How would you rate (your division's) continuing and new business prospects over the next three years or so?



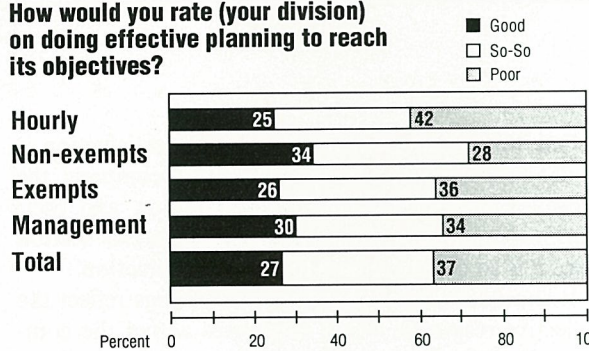
How would you rate (your division) on having high quality at each step of the production or work process so that re-work and waste are minimized?



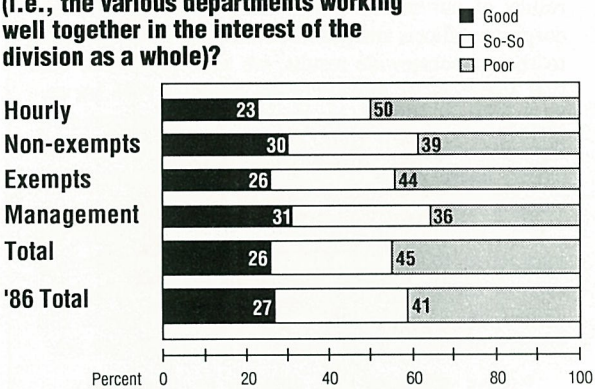
How would you rate (your division) on being efficient (that is, doing work at low cost for the amount accomplished)?



How would you rate (your division) on doing effective planning to reach its objectives?



How would you rate (your division) on having a cooperative atmosphere (i.e., the various departments working well together in the interest of the division as a whole)?



Analysis: Employees are moderately favorable in rating the corporation as an effectively managed and well-run organization (44% positive). In fact, all groups except hourly employees are more favorable today in their ratings of the corporation than they were in 1986. Employees are less positive about the operation of their own division. Many employees—and again, hourly employees especially—do not believe their division is effectively run (46% unfavorable).

Employee responses regarding various aspects of division performance (quality, competitiveness, efficiency, planning) show a range of strengths, as well as opportunities for improvement.

As in 1986, all employee groups are highly favorable about the final quality of their division's products and services. Fairly good ratings are also given the division's ability to compete effectively for business.

However, employees are consistently less positive than in 1986 about the in-process quality of products or processes at the division, that is, the quality at each step of the production process. Thirty-five percent of the hourly employees rate in-process quality as poor.

Moderately unfavorable ratings are given divisions on the efficiency of operation (37% unfavorable) and effectiveness of planning (37% unfavorable).

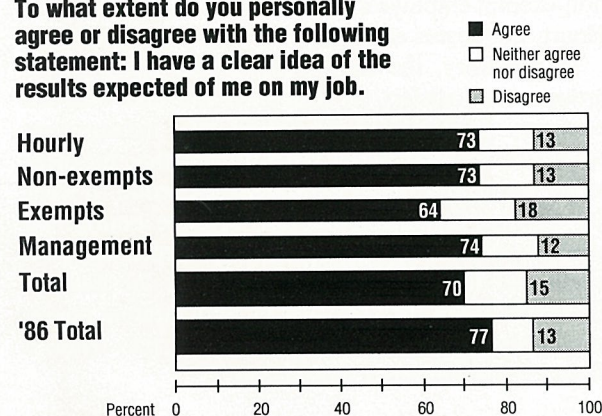
As in 1986, the survey shows quite unfavorable ratings of cooperation across departments. Exempt and hourly employees are most strongly unfavorable (44% and 50%, respectively).

Overall, this section notes several strengths. Employees are highly satisfied with the quality of products and services, and they believe their division competes effectively for business. However, employees are much less favorable regarding in-process quality, planning to objectives, the cooperation within the division, and the efficiency with which work is accomplished.

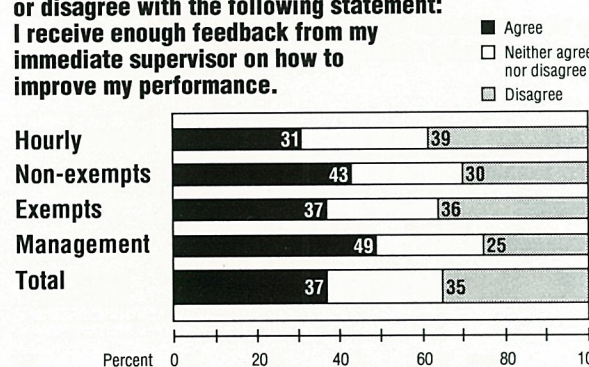
3. Performance Management and Supervision

Explanation: Here the survey moves from the overall effectiveness of the corporation and division to specific work group issues. The focus now is on issues relating to how employees are doing at their job and their relationship with their supervisor. Areas explored include recognition, performance expectations, performance improvement, and supervisor competency.

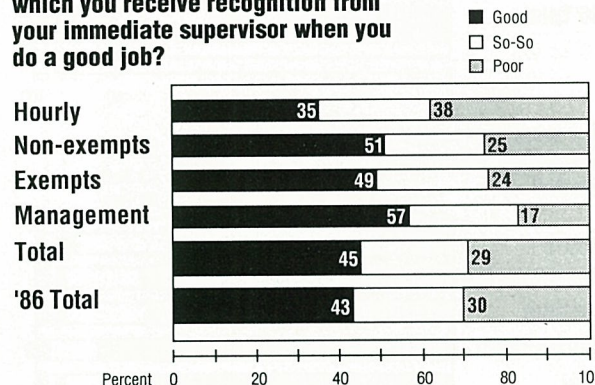
To what extent do you personally agree or disagree with the following statement: I have a clear idea of the results expected of me on my job.

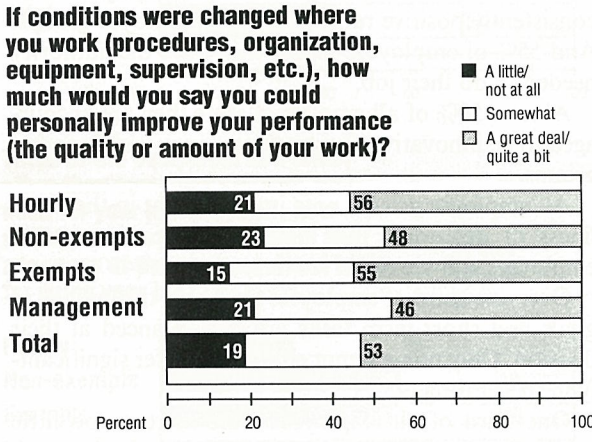
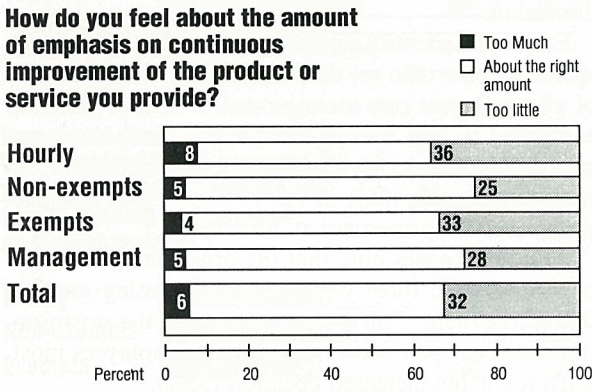
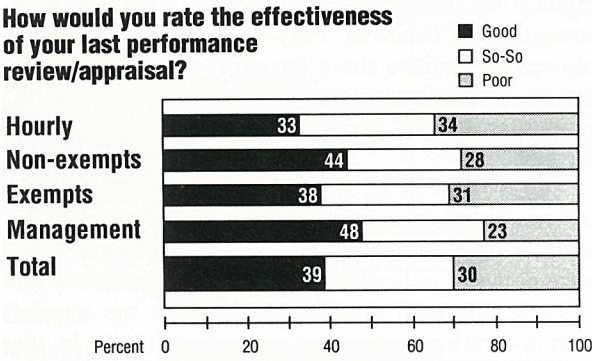
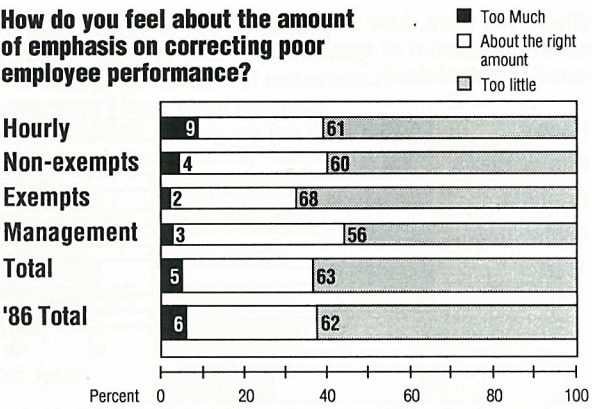


To what extent do you personally agree or disagree with the following statement: I receive enough feedback from my immediate supervisor on how to improve my performance.



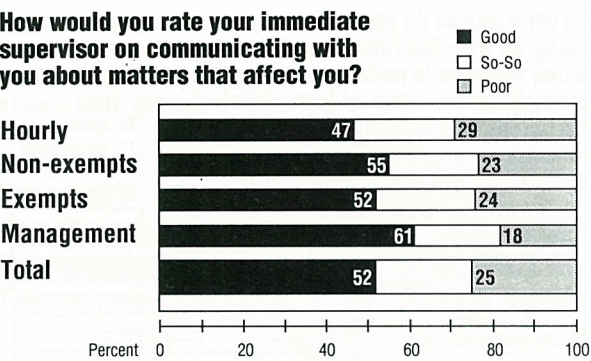
How would you rate the extent to which you receive recognition from your immediate supervisor when you do a good job?





What would be the most important things that need to be changed for you to improve your performance?

Salaried	Hourly	Major categories of comment
17%	19%	More competent supervision/better feedback/clearer direction.
13	11	Better working conditions/climate control/lighting.
11	9	Access to information/communication between shifts.
9	21	Better tools and equipment/access to materials/better maintenance.
8	3	Decrease bureaucracy/better planning and scheduling/more timely decisions.
6	—	Increase staff.
6	9	Better training/more training.
5	—	More freedom to do my job/more authority at lower levels.
4	8	Better pay/reward good workers.
3	10	Treatment with respect and dignity/trust and concern for employees.
3	—	Encourage new ideas/decrease resistance to change.
15	10	Miscellaneous.
100%	100%	



Analysis: While employees say they know what is expected of them on the job, they do not rate feedback, recognition, and performance management nearly as highly. Employees at all levels report they are clear about what is expected of them on the job. However, there has been a slight decline in this area since 1986.

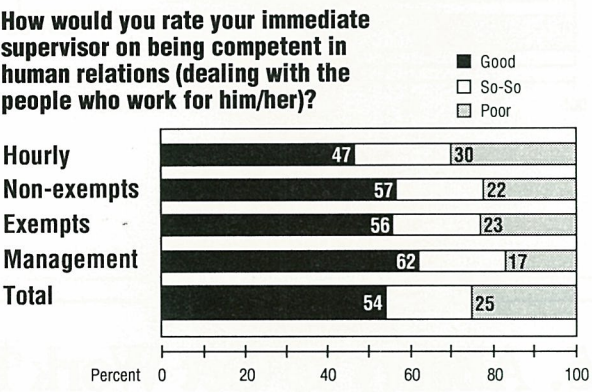
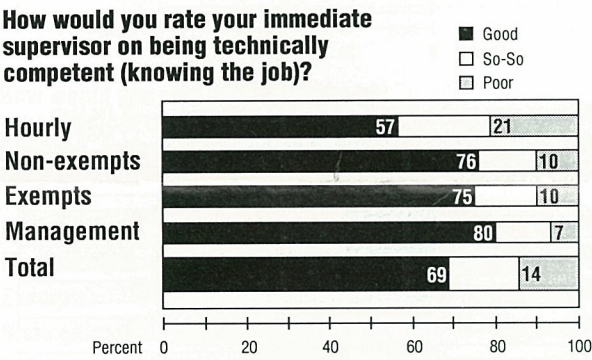
Employees generally feel they receive recognition for good work. But significant numbers of employees in all groups rated the effectiveness of their last performance review as poor.

Over 60% of employees state that about the right amount of emphasis is being placed on continuous improvement. But 32% say the emphasis needs to be increased where they work. Exempt and hourly employees are the strongest in identifying the need for increased emphasis.

Many employees identified changes that would lead to improvements in their own performance. Employees were asked to identify the most important things that could be changed to improve their performance. The responses cover a wide range of improvement areas. Seventeen percent of the salaried and 19% of the hourly employees who responded said that improvement of supervision and job related communication was most important. They noted the value of more timely performance feedback, clearer task direction, and clearer objectives. Hourly employees most frequently noted the need for better access to materials, tools and equipment, as well as better equipment maintenance. Employees in both groups point to improvements needed in working conditions. In addition, a fair number of employees suggest that improved communication within and between groups, as well as increased access to job information, would have a positive impact.

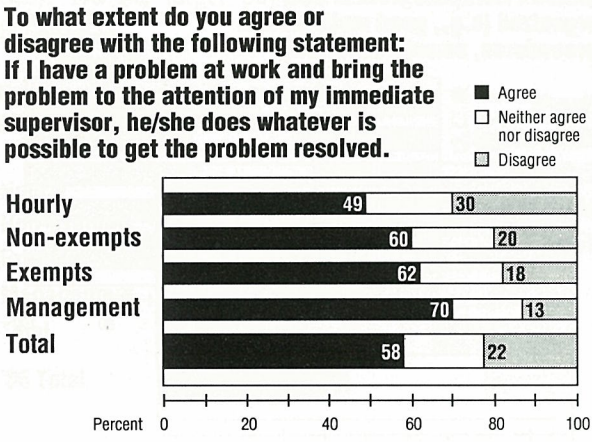
Employees at all levels believe that their immediate supervisor is technically competent — he or she “knows the job.” When it comes to “people skills” and communicating, 75% of employees rate their supervisor as “good” or “so-so,” while 25% rate them as “poor.”

In summary, employees know what is expected of them and consider their supervisor to be technically competent. But employees do not receive as much feedback on performance or job-related information as wanted.



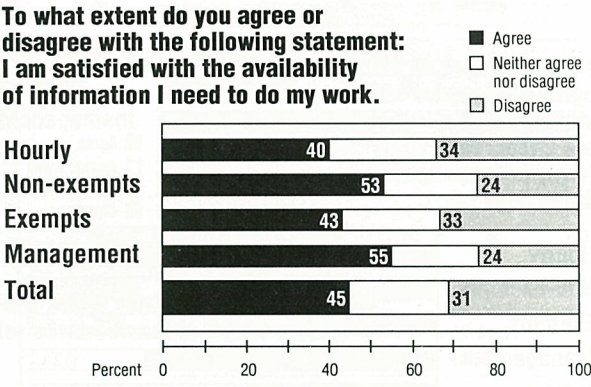
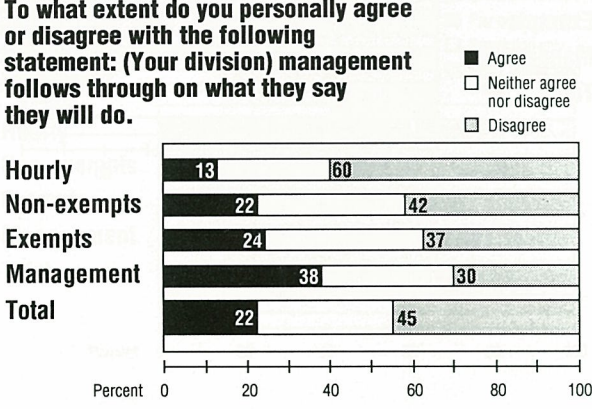
4. Communications and Decision Making

Explanation: In this section, questions focused on internal communications and decision making. These areas have a dramatic impact on an individual's feelings of satisfaction with their job, their relationship with their work group, and their ability to perform.

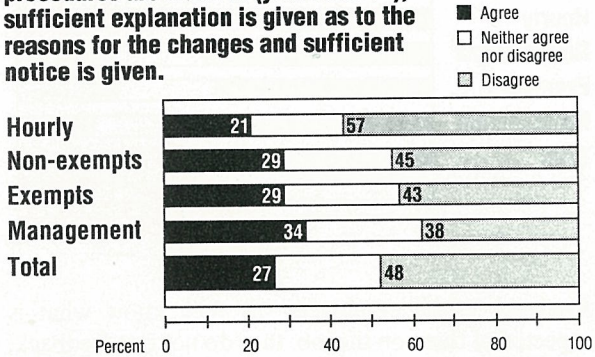


Employees were asked a series of questions about communications: employee to management, management to employee, and group to group.

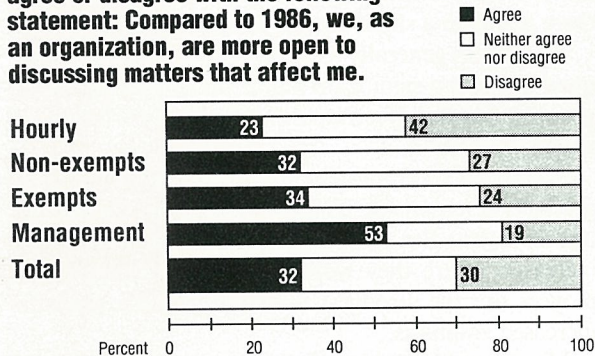
Another series of questions dealt with the topic of decision-making, including timeliness, responsibility, authority, and innovativeness. Employees were also asked about priorities where they work and about the balance of long-term goals and short-term tasks.



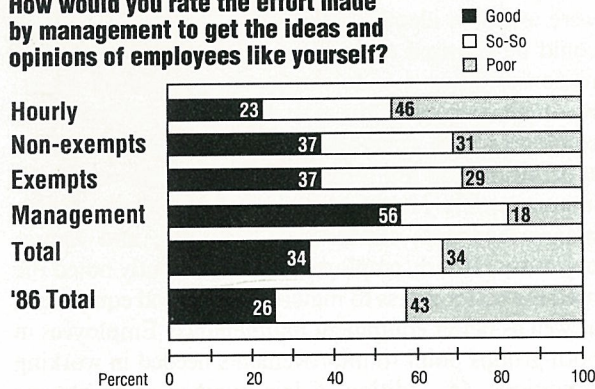
To what extent do you agree or disagree with the following statement: When changes in policies or procedures are made at (your division), sufficient explanation is given as to the reasons for the changes and sufficient notice is given.



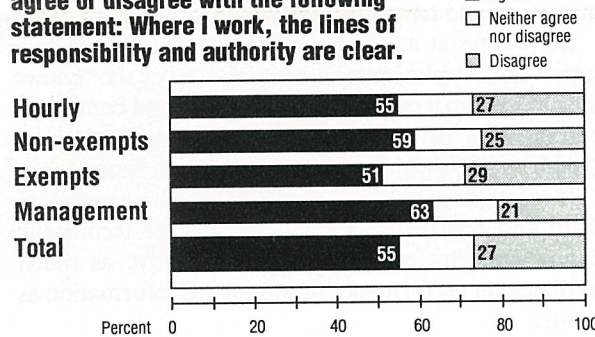
To what extent do you personally agree or disagree with the following statement: Compared to 1986, we, as an organization, are more open to discussing matters that affect me.



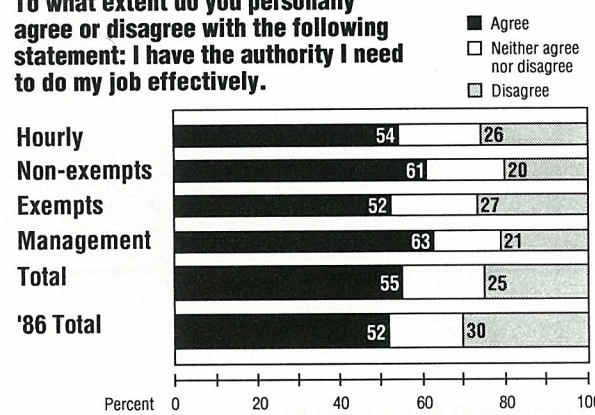
How would you rate the effort made by management to get the ideas and opinions of employees like yourself?



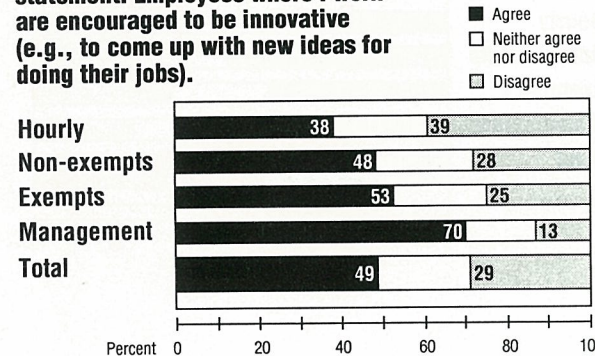
To what extent do you personally agree or disagree with the following statement: Where I work, the lines of responsibility and authority are clear.



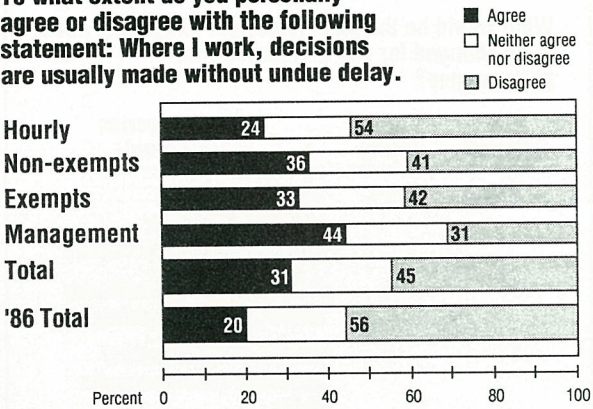
To what extent do you personally agree or disagree with the following statement: I have the authority I need to do my job effectively.



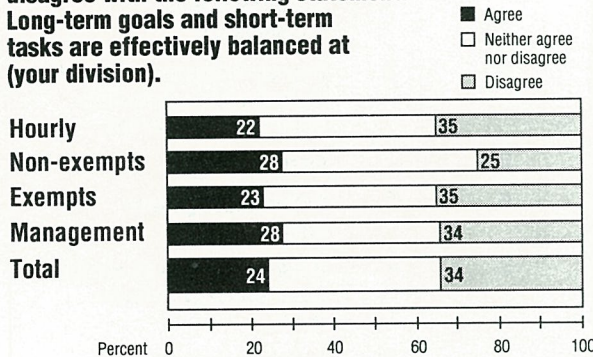
To what extent do you personally agree or disagree with the following statement: Employees where I work are encouraged to be innovative (e.g., to come up with new ideas for doing their jobs).



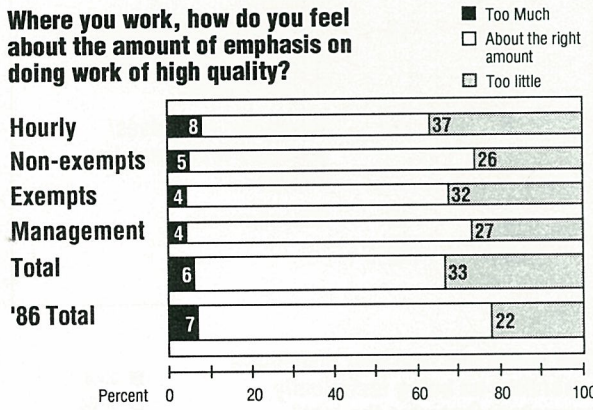
To what extent do you personally agree or disagree with the following statement: Where I work, decisions are usually made without undue delay.



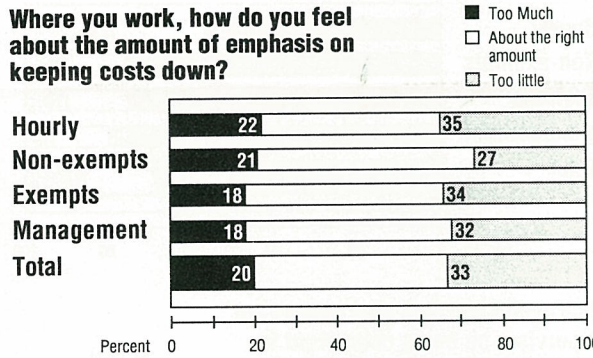
To what extent do you agree or disagree with the following statement: Long-term goals and short-term tasks are effectively balanced at (your division).



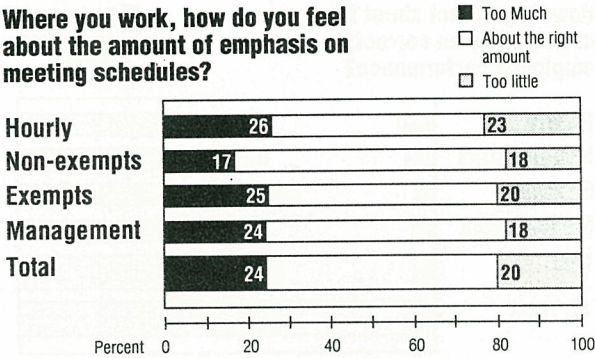
Where you work, how do you feel about the amount of emphasis on doing work of high quality?



Where you work, how do you feel about the amount of emphasis on keeping costs down?



Where you work, how do you feel about the amount of emphasis on meeting schedules?



Analysis: As in 1986, responses to questions on communication and decision making show a range of both strengths and concerns. Fifty-eight percent of all employees are positive about the effort made by supervisors to resolve problems brought to their attention. But ratings are mixed on division management's follow through.

Almost half of all employees state they have the information necessary to do their work, but a similar number report that they do not receive timely or complete notice of policy and procedure changes.

There has been significant change in the area of communicating with employees, particularly in the openness of management and supervision to ideas and discussion.

Employees identify significant improvement in management's efforts to get their ideas. Thirty-four percent of all employees rate management efforts as positive, compared to 26% in 1986. Responses of all employee groups improved. Management responses improved most significantly (56% in 1989, 37% in 1986) with less pronounced improvement at other levels.

Also, employees note that the organization is more open now than three years ago to discussing matters that affect them. Thirty-two percent say the organization is more open, with management employees most often reporting increased openness (53%).

The clarity of authority and responsibility receives consistently positive ratings from all employee groups. And 55% of employees report they have the authority needed to do their job.

Almost 50% of all employees state they are encouraged to be innovative. But responses vary widely across groups.

All employee groups note improvement in the timeliness of decisions. But a significant percentage of employees still see room for improvement (45%).

Over one-third of employees (34%) say the long-term goals and short-term tasks are not balanced at their division. Only non-exempt employees differ significantly in their rating (25%).

One-third of all employees state there is too little emphasis where they work on doing high quality work and on keeping costs down. A higher percentage of employees (33%) note there is not enough emphasis on doing work of high quality, as compared to 1986 (22%). Almost equal numbers of employees believe that too much (24%) and too little (20%) emphasis is placed on meeting schedules.

5. Ability to Get Work Done

Explanation: Here the survey dealt with a variety of factors that can help, or hinder, a work group or employee's ability to get the job done.

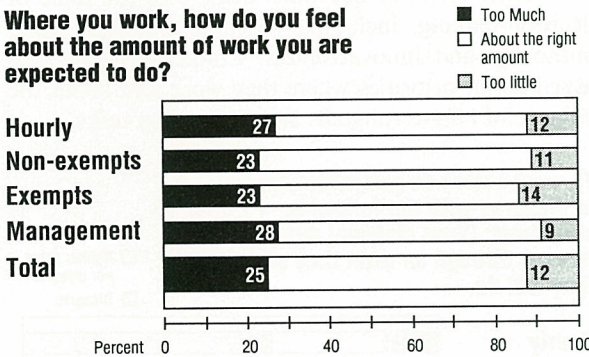
The issues explored included how the work is organized, the effect of unnecessary paperwork, and the amount of work expected. In addition, questions were asked about the adequacy of training and the degree to

which teamwork is actively encouraged and recognized.

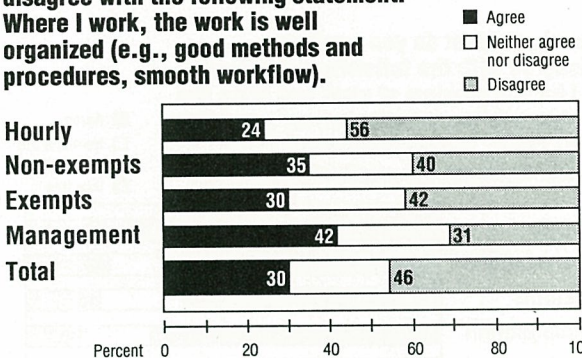
Employees also rated the availability and adequacy of equipment and tools, computer systems, and the parts and materials used in their work.

Finally, employees rated their working conditions — the physical working conditions as well as the safety of the workplace.

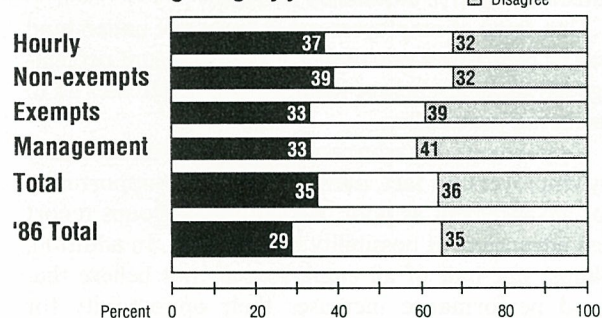
Where you work, how do you feel about the amount of work you are expected to do?



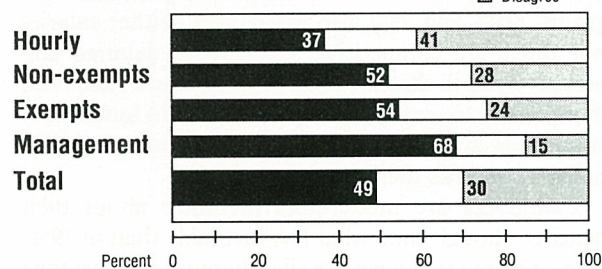
To what extent do you agree or disagree with the following statement: Where I work, the work is well organized (e.g., good methods and procedures, smooth workflow).



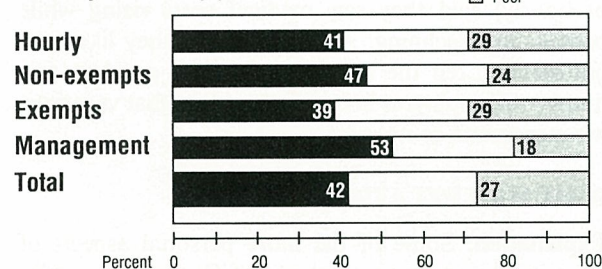
To what extent do you personally agree or disagree with the following statement: The amount of unnecessary paperwork I have to do seriously interferes with getting my job done.



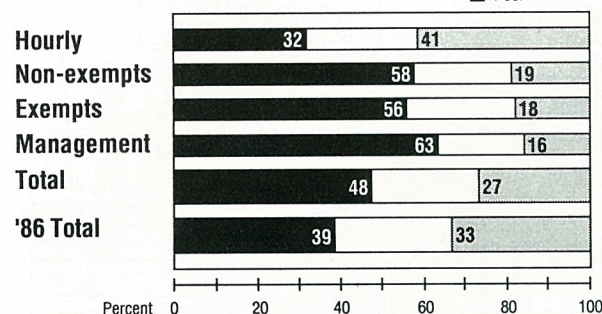
To what extent do you agree or disagree with the following statement: Where I work, cooperation and teamwork are actively encouraged and recognized.



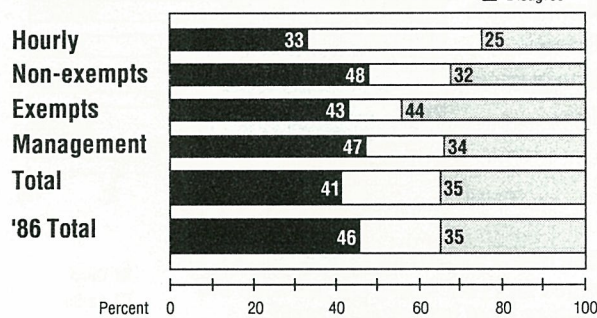
How would you rate the training you have received in the company for your current job? (Consider both formal training and informal on-the-job training.)



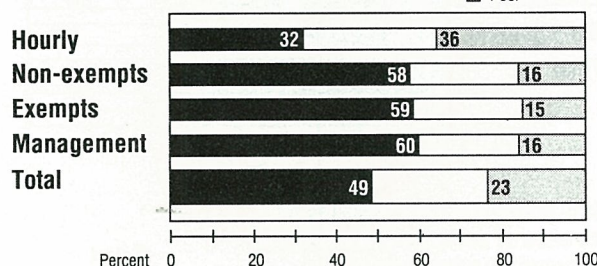
Think of the equipment and tools, other than computer systems, you need for your job. All in all, how would you rate the availability and adequacy of the equipment and tools for doing your job?



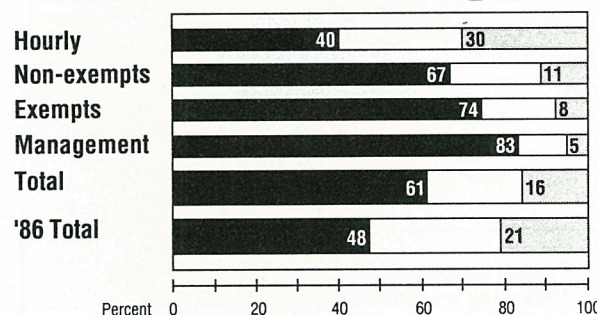
To what extent do you agree or disagree: I am satisfied with the availability and adequacy of the computer systems (terminals, machine time, etc.) I need to do my work.



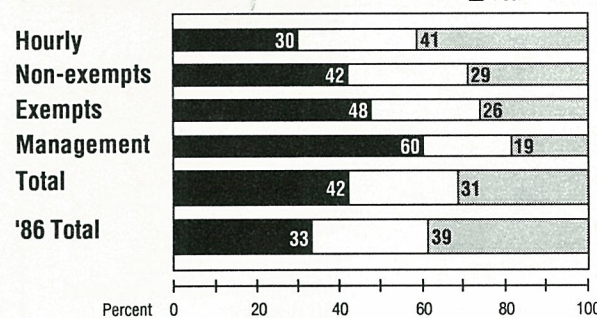
How would you rate the availability and quality of the parts, materials, or supplies you use in your work?



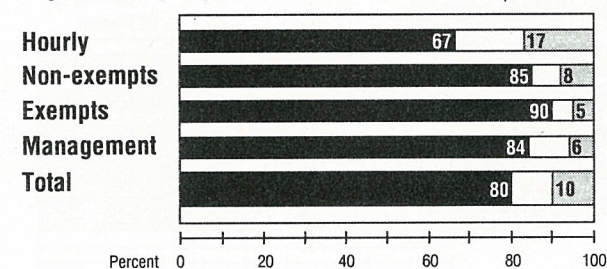
How would you rate (your division) on providing a safe and healthy workplace for employees?



How would you rate other aspects of your physical working conditions (lighting, space, housekeeping, temperature, etc.)?



To what extent does the use/abuse of drugs and alcohol impact the productivity and quality performance of your work group?



Analysis: When asked to rate various aspects of the workplace, employees indicate some positive areas as well as several areas where there has been significant improvement since 1986.

In rating the amount of work expected, at least 60% of employees in all groups say the workload is about right. However, 46% state there is room for improvement in how the work is organized.

All employee groups note a reduction in the amount of unnecessary paperwork. Management employees note the greatest improvement while other employee groups report a somewhat smaller improvement.

A moderately favorable percentage of employees state that teamwork and cooperation is actively encouraged and recognized, but the ratings differ widely among groups.

Training received mixed reactions. While over 40% of all employees say they have received good formal and informal training for their job, over one-fourth rate the training as poor. Hourly and exempt employees are the most unfavorable.

Employees report that the availability of equipment and tools has improved significantly since 1986. Nonetheless, hourly employees still note a need for continued improvement. Moreover, employees cite a decline in the availability and adequacy of computer systems. Salaried employees are fairly pleased with the availability of parts and materials; hourly employees are less so.

When asked to rate physical working conditions, employees are much more positive about all aspects than they were in 1986. Sixty-one percent of all employees rate their division favorably on providing safe and healthy conditions, compared to 48% in 1986. Other aspects of working conditions are also more highly rated by all groups (42% favorable in 1989; 33% in 1986).

Eighty percent of all employees report little or no impact on productivity and quality due to the use or abuse of drugs and alcohol. However, about one-sixth of hourly employees state there is significant impact to their work group's productivity and quality.

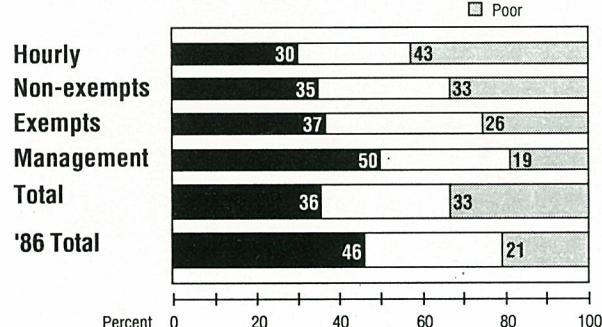
6. Treatment of Employees

Explanation: This section of the survey dealt with a variety of human relations or "people" issues. The questions were designed to find out how employees feel about the economic and employee relations issues which contribute to their overall satisfaction.

A. ECONOMIC ISSUES

Explanation: Employees here rated the pay and benefits they receive. Their views were sought regarding the pay system: Do they understand pay and promotion practices? Do the larger pay increases go to the better performers?

How would you rate the amount of pay you receive for your job?

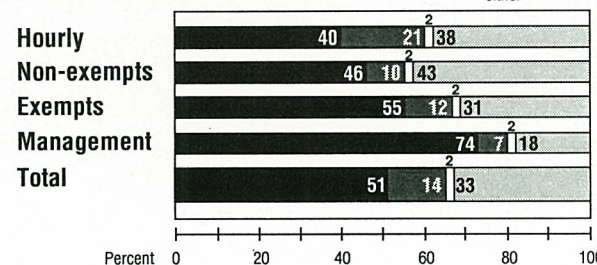


Similarly, employees were asked for their views on opportunities for advancement, the link between performance and promotion, and the division's effort to promote from within. The issue of job security was also addressed.

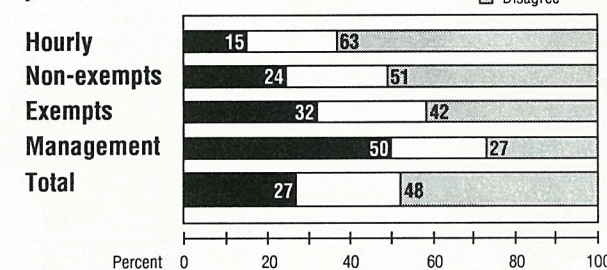
Employee benefit questions included an overall rating of benefits, as well as several specific questions for employees who participate in Dynaflex.

In addition, two write-in questions gave employees the opportunity to comment on pay, promotion and benefit topics.

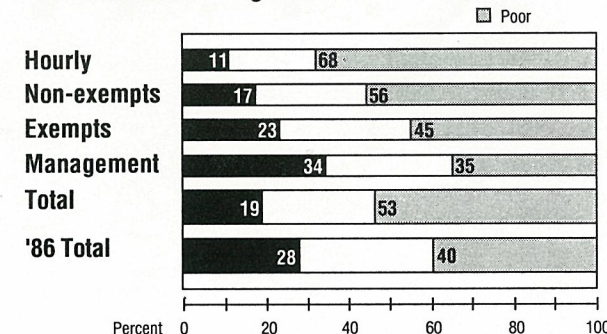
Do you understand the pay and promotion practices that affect you (e.g., how pay increases are determined, how employees are selected for promotions or other positions)?



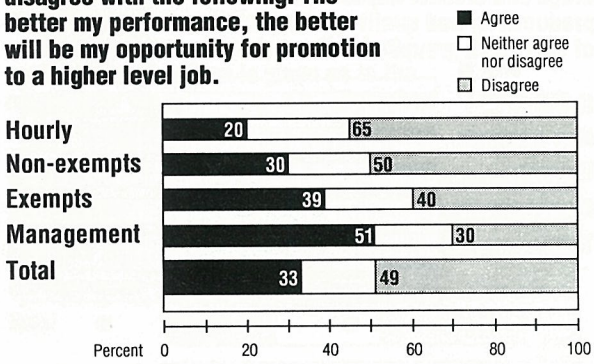
To what extent do you agree or disagree with the following: For employees in my kind of work, the bigger pay increases go to the better performers.



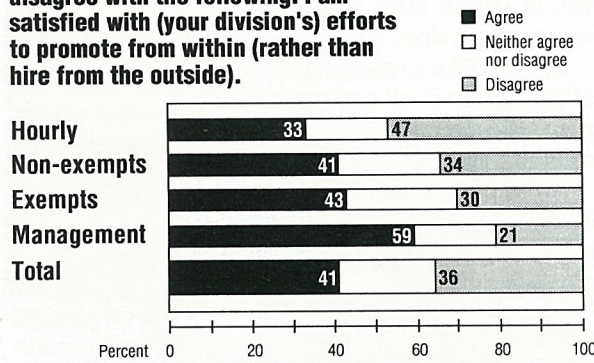
How would you rate your opportunity for advancement to higher levels?



To what extent do you agree or disagree with the following: The better my performance, the better will be my opportunity for promotion to a higher level job.

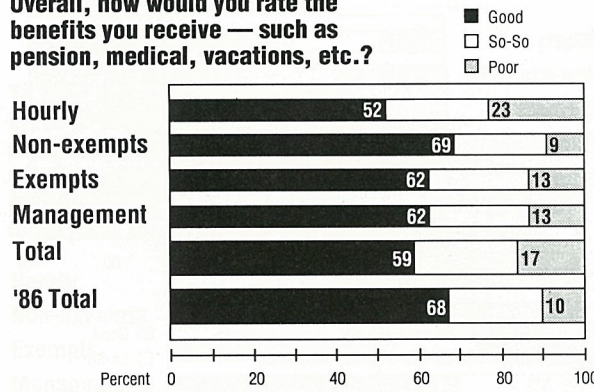


To what extent do you agree or disagree with the following: I am satisfied with (your division's) efforts to promote from within (rather than hire from the outside).

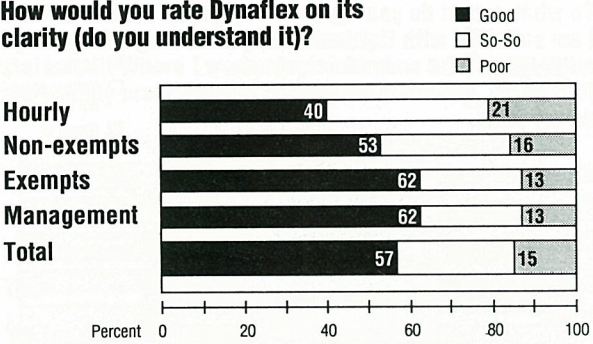


Further comments regarding pay, promotion, job awareness, career development opportunities, or other employment practices at (your division).		
Salaried	Hourly	Major categories of comment
22%	—%	Increase not related to performance/tied to who you know/tied to visibility.
14	25	Promotion on favoritism/nepotism/political.
14	6	Raises not keeping to inflation/not competitive/need COL increases.
9	23	Lack of advancement opportunity/declining business is hurting.
7	21	Salaries not competitive with area, with industry.
6	—	Pre-selection in job posting.
6	—	Deal with poor performers/performance reviews not taken seriously.
5	3	Little promotion from within/don't look hard enough inside.
4	3	New hires make more than current employees.
4	4	Overtime handled poorly/need compensation for overtime.
3	—	Little opportunity for women.
—	6	Need merit/incentive pay.
6	9	Miscellaneous.
100%	100%	

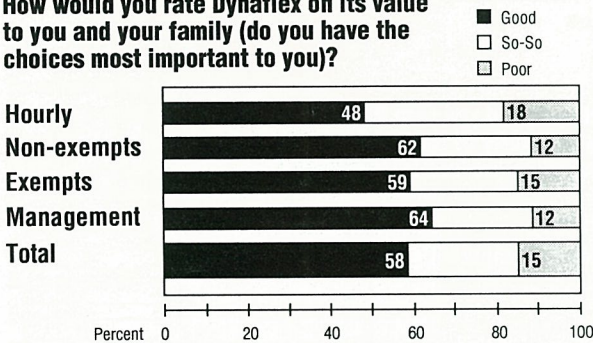
Overall, how would you rate the benefits you receive — such as pension, medical, vacations, etc.?



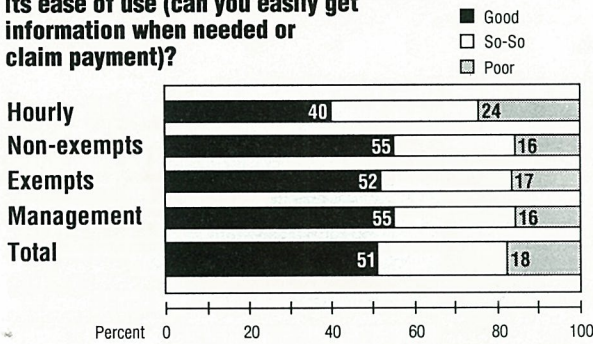
How would you rate Dynaflex on its clarity (do you understand it)?



How would you rate Dynaflex on its value to you and your family (do you have the choices most important to you)?

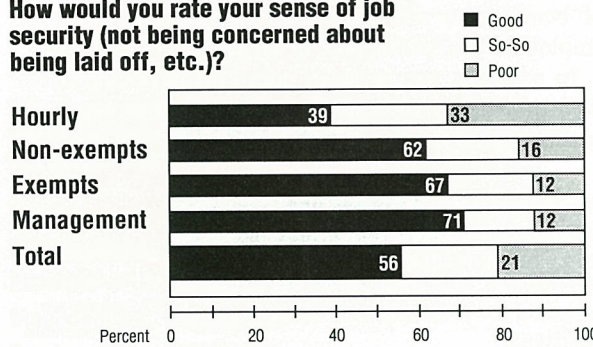


How would you rate Dynaflex on its ease of use (can you easily get information when needed or claim payment)?



Further comments regarding benefits program (including reactions to Dynaflex, pensions, medical, vacation, etc.).		
Salaried	Hourly	Major categories of comment
30%	20%	Costs going up too much/Dynaflex a cutback/can get cheaper outside.
21	16	Vacation inadequate/not competitive.
10	11	Good program/like options/satisfied.
9	—	Not flexible enough/why couples pay twice?
5	3	Not explained well/no information available/Aetna bill difficult.
4	4	Need vision plan.
3	8	Retirement plan needs improvement.
2	3	Hard to collect medical benefits or sick pay/poor service from Aetna.
—	15	Need increased medical insurance/dental benefits.
—	11	Need more sick days.
16	9	Miscellaneous.
100%	100%	

How would you rate your sense of job security (not being concerned about being laid off, etc.)?



Analysis: When asked about their rate of pay, slightly over one-third of all employees said they are satisfied (36%). A similar percentage stated that they are unsatisfied (33%). This is a significant change from the 46% satisfied and 21% unsatisfied in 1986.

One-third of employees say they do not understand pay or promotion practices. And a significant percentage (48%) do not believe that bigger pay increases go to the better performers.

Opportunity for advancement is not rated favorably by employees. In fact, over 50% rate their opportunity for advancement as poor. All employee groups report less advancement possibility than in 1986. In addition, almost one-half of all employees do not believe that good performance increases their opportunity for promotion.

Employees were asked for written comments on pay, promotion and development opportunities. A significant percentage of both hourly and salaried groups who responded (25% and 14%, respectively) said that promotions are based on favoritism or "politics". Both groups (21% and 7%) also assert that neither salaries nor raises are competitive. One in five salaried employees write in that they would like to have raises tied more clearly to performance. Almost one in four hourly employees stated that lack of advancement opportunities concerns them.

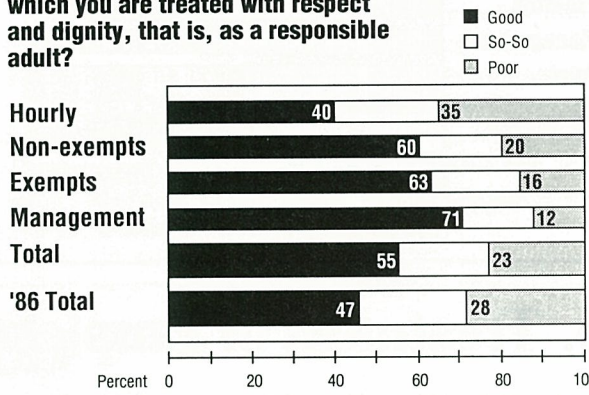
Employees are moderately favorable about their benefits, though somewhat less favorable than in 1986. Non-exempt employees are slightly more positive than other groups. The Dynaflex program received positive ratings on its clarity, value, and ease of use.

In response to a write-in question in which employees were asked for their comments about benefits programs, many employees who responded (30% of salaried, 20% of hourly) said they saw medical costs rising while benefits are declining. About 10% said they liked the options and felt the benefit program is good. A fair number of employees in both groups said that vacations are inadequate or not competitive.

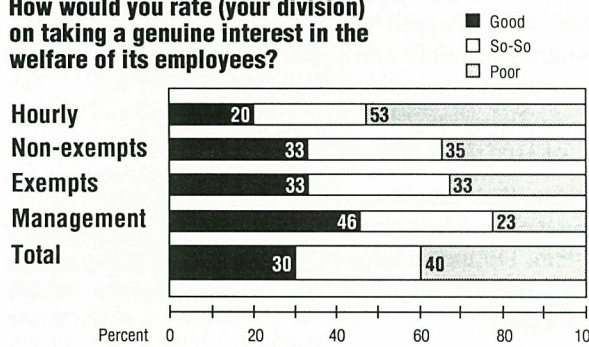
B. HUMAN RELATIONS

Explanation: Some of the more personal aspects of what its like to be an employee of General Dynamics were asked in this section of the survey. Employees were asked about the level of respectful treatment and the extent that their division is interested in employee welfare. Several questions tapped the consistency of policy administration. Employees also rated the division's efforts to provide equal opportunities to all employees.

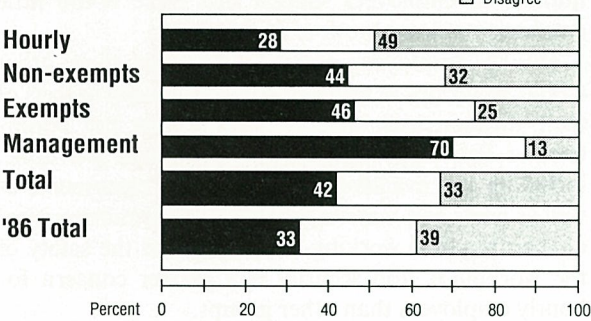
How would you rate the extent to which you are treated with respect and dignity, that is, as a responsible adult?



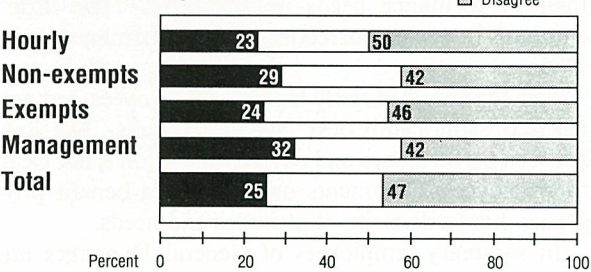
How would you rate (your division) on taking a genuine interest in the welfare of its employees?



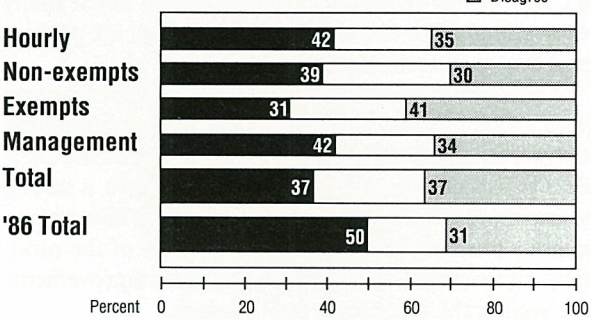
To what extent do you personally agree or disagree with the following statement: Employees where I work can get a fair hearing for their complaints.



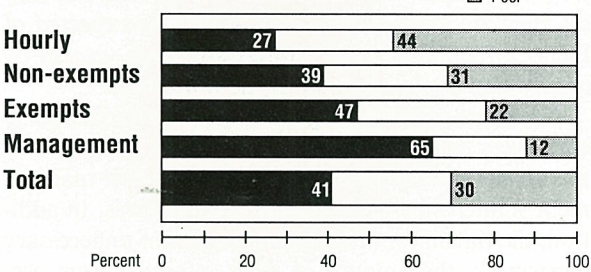
To what extent do you personally agree or disagree with the following statement: In general, supervisors administer policies consistently from work unit to work unit and department to department.



To what extent do you agree or disagree with the following: Overtime policies and practices are applied consistently at (your division) (i.e., how employees are selected for overtime, how overtime compensation is handled, etc.).



How would you rate the current efforts of (your division) to provide equal opportunities (EEO) to all employees?



Analysis: Employees offer mixed views of their division's employee relations. Over one-half (55%) say they are treated with respect and dignity. This is an increase from the 1986 response rate of 47%. Hourly employees are least positive. But 40% of all employees do not feel their division takes a genuine interest in them.

Significantly more employees now say they can get a fair hearing for complaints. Though there is improvement (33% in 1986; 42% in 1989), significant dissatisfaction remains in all employee groups except management. Again, hourly employees are least positive.

There is a general consensus among all employee groups regarding the consistency of policy administration. While there is improvement from 1986, only one-fourth of employees say that policies are administered consistently from group to group. The application of overtime policies and practices remains a problem for 37% of all employees.

Employees give a lukewarm rating (41% favorable) to their division's efforts to provide equal opportunities for all employees. While 65% of management says the division is doing a good job, only 27% of hourly employees agree.

Overall, the survey shows moderate to high levels of satisfaction with benefits and job security. All employee groups note improvement in how they are treated and in the fair handling of complaints. However, employee ratings of pay and advancement opportunity have declined among all groups.

7. Business Practices

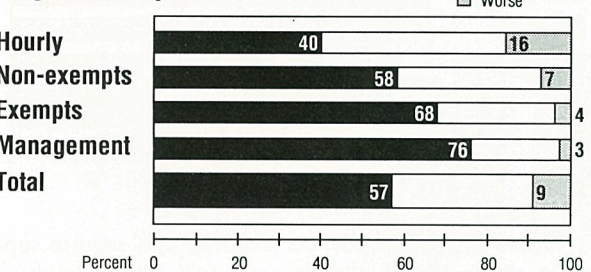
Explanation: In recent years, General Dynamics has changed a number of business practices and administrative procedures. This part of the survey dealt with these changes and with business practices and ethics in general.

Employees were asked a series of questions on the changes in business and administrative procedures — were they the right kinds; in the right amount; what

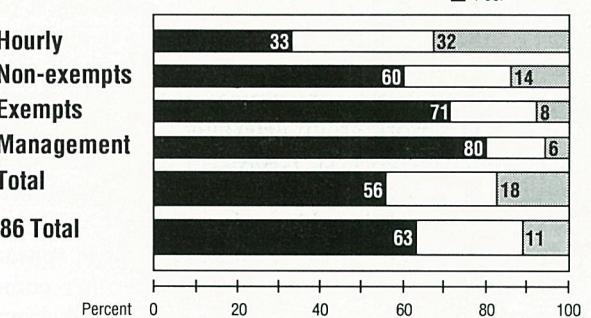
was the impact on work efficiency and the division's competitiveness? Space was provided for additional comments on the changes in business practices and administrative procedures.

Employees were also asked about their perceptions of the business ethics of their division and the company's image with the public. They then provided their perceptions of the Ethics Hotline.

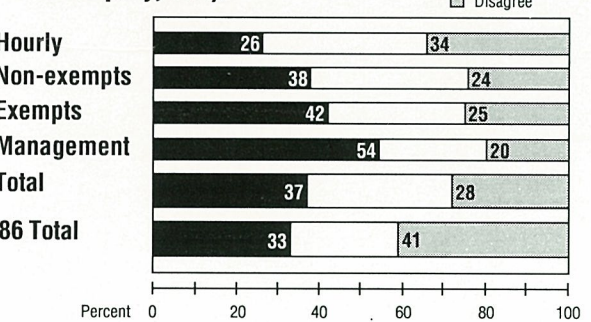
Compared to about three years ago, how would you rate General Dynamics' image with the public at this time?



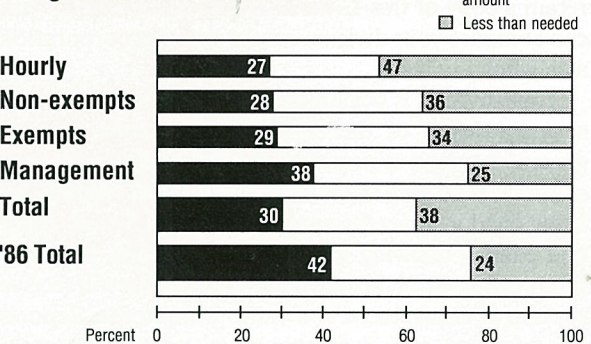
How would you rate (your division) on being ethical in its business dealings?



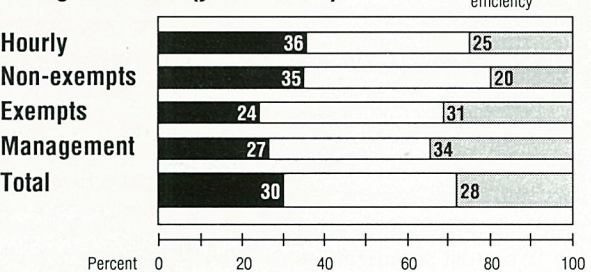
To what extent do you agree or disagree with the following statement: The right kinds of changes are being instituted (the changes have gotten at the right issues, at the right levels of the company, etc.).



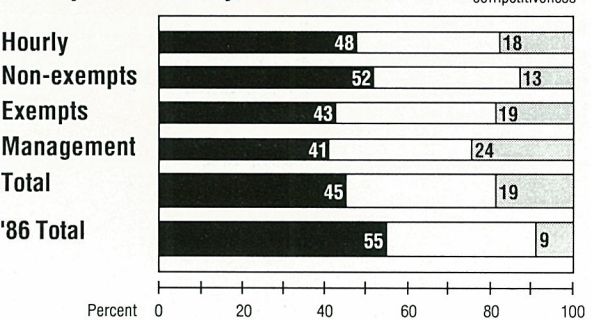
How do you feel about the amount of change that has been instituted?



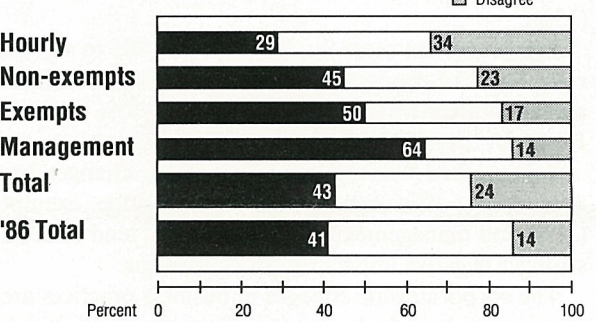
What impact do you believe each of these corporatwide changes is having on the efficiency with which work gets done at (your division)?



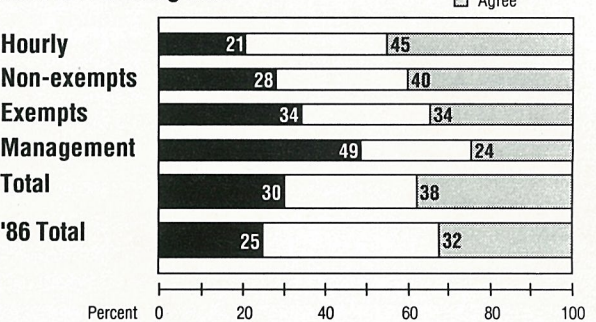
What impact do you believe each of these corporatwide changes is having on the ability of (your division) to compete effectively for business?



To what extent do you agree or disagree with the following statement: If I were to use the Ethics Hotline, the situation would be investigated and action taken as warranted.



To what extent do you agree or disagree with the following statement: If I were to use the Ethics Hotline, I would probably be hurt in some way later on for doing this.



Comment on any of the changes that have been made in business practices and administrative procedures (e.g., impact on your ability to do your work, extent to which implemented where you work).

Salaried	Hourly	Major categories of comment
20%	4%	Time cards too complicated/ time cards take too much time/need to change "All Hours Worked" policy.
19	17	Don't trust Ethics Hotline/ fear retaliation/ineffective.
15	5	Changes have helped/ procedures improved.
14	—	Created too much bureaucracy/increased administrative overhead.
11	18	Not enough change/ superficial/not fully implemented.
6	16	Upper management involved in ethics problems, not us.
5	—	Expense reporting procedure overwhelming and complicated.
—	23	Poor managerial skills/ quantity not quality focused/ poor communication between departments.
10	17	Miscellaneous.
100%	100%	

Analysis: Almost 60% of employees feel that General Dynamics' public image has improved over the past three years. Employees in general give a similar rating to their division on being ethical in its business dealings. As in 1986, the hourly employees were least favorable (33%).

Employees are more inclined than in 1986 to say the right kinds of changes are being instituted in business and administrative practices (37% in 1989, 33% in 1986). However, they feel that more needs to be done.

When asked what the impact of these changes has been on the efficiency of getting work done, exempt (31%) and management (34%) employees tend to see a stronger negative impact than other groups.

The corporatewide changes in business practices are also seen to have had a negative impact on a division's ability to be competitive. While the overall results tend to the positive side (45% say the changes are increasing competitiveness), the percentage reporting a negative impact has doubled (19% in 1989, 9% in 1986).

Employees are moderately favorable on rating the effectiveness of the Ethics Hotline, with hourly employees less favorable than other groups (29% favorable for hourly, 43% overall). A significant percentage of all employees believe they might be hurt for using the Hotline, with non-exempt and hourly groups most concerned (40% and 45%, respectively). In fact, each employee group increased in the level of concern from 1986.

A write-in question that asked for further employee comments on business practices and administrative changes provides clarification. Many employees asserted that the changes have been superficial. Fourteen percent of salaried employees say the changes have increased bureaucracy and paperwork. In fact, one in five salaried employees commented on the difficulty and complexity of time card reporting.

A significant number of employees note they do not feel comfortable using the Ethics Hotline. Some are not sure appropriate action will be taken while other employees say they don't trust the confidentiality.

Summary of Corporatewide Survey Findings

In reviewing the results presented in this report, there are clearly significant strengths seen in General Dynamics and in the divisions. Employees have noted many operational areas and current practices that are positive and they want continued.

These key strengths include the overall effectiveness with which General Dynamics manages and employees' optimism, at the time of the survey, about future business prospects. In addition, employees have a strong sense of pride in their divisions. Employees continue to express positive feelings about the quality of the products and services at their division and improvements are seen in the company's public image.

Employees note several strengths that impact their ability and motivation to perform effectively. They say they receive satisfaction from the work itself, they consider their supervisors technically competent, and they say they are given a clear idea of what is expected of them. In addition, good ratings are given, except by hourly employees, of safety in the workplace.

A number of areas are given more positive ratings by employees than in 1986. More employees now say they are treated with respect and dignity, and that management is interested in their ideas and opinions. In addition, the timeliness of decisions, impact of unnecessary paperwork, the amount of work expected from employees, and how that work is organized have all improved. Significant improvement has been seen in physical working conditions and in the availability of equipment and tools.

Employees candidly highlight areas where improvement is still needed. While employees rate the quality of products and services positively, *in-process* quality

receives lower ratings than in 1986. And a significant number of employees suggest that there is too little emphasis on doing work of high quality.

Hourly employees are less favorable than other employee groups in their assessment of many aspects of their division and workplace. They see key opportunities for improvement in getting their job done, including the availability of tools and equipment, as well as parts and materials. They are also more critical of their physical working conditions and the safety of the workplace. Job security is a greater concern for hourly employees than other groups.

Performance management — giving positive feedback and coaching for improved performance — is an area all employee groups point to for improvement. While they know what supervisors expect of them, employees say they do not receive enough job-related information, nor do they get enough information when their performance needs improvement. "Too little" emphasis is seen on correcting poor performance, as in 1986.

Benefits are rated fairly highly by employees, but pay received significantly less favorable results. The link between performance and pay or promotion is not clear to employees. Comments on changes in benefit programs show a diversity of attitudes and needs.

In summary, employees of General Dynamics are proud of their company and the final quality of its products. They have seen significant improvement in some areas of operations since the first survey in 1986. But employees point to the need for further attention to such areas as in-process quality, availability of equipment, treatment of employees and pay for performance.

Next Steps In Survey by Naomi M. Morales, Corporate Survey Director

This publication of corporatewide results is just the first step in the process of feedback and action planning. Each of your divisions will be distributing a similar document in the next few weeks, sharing the survey results for your own location. You are encouraged to retain a copy of this *General Dynamics World*, so you can compare your division results with the corporation as a whole.

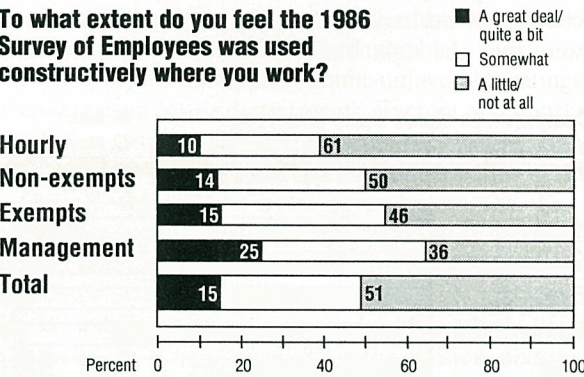
Your division is beginning the feedback process with a presentation of the division-level results to your general manager or president, and his staff. Results will also be shared with union leadership. These sessions are being conducted by the consulting firm of Sirota, Alper and Pfau. Following each of these division presentations, supervisors throughout your division will receive reports of department and work group units. Reports are provided only for those units with 10 or more employees who took the survey and identified that unit as their "organization."

Facilitators and trainers are prepared to assist supervision as required with the skills of successful feedback and action planning. Each division has a team of at least three lead trainers, but some have more trainers/coaches depending on the division's size and needs.

Throughout February and March, supervisors will be holding feedback meetings to give employees the work group results. Following this feedback, supervisors and work groups will identify the strengths and problems within their area. Each group will then select the five most significant concerns of the work group. The supervisor, in collaboration with employees, is responsible to follow through with planning and implementation of actions to improve the issues.

As many of you noted when asked how to increase the effectiveness of the survey, taking action is a key to success. Showing that concerns are heard and demonstrating use of the results to improve operations are, by far, the most frequent recommendations to increase constructiveness of the survey process.

To what extent do you feel the 1986 Survey of Employees was used constructively where you work?



There will, no doubt, be concerns that require support of employees outside your own group. In these cases, employees will determine the most efficient way to share resources, information and time in order to make the necessary improvements.

The intent of feedback and action planning is to increase the effectiveness of work groups at all levels and in all functions of the company. This continuous improvement process is the ultimate goal of the survey process. As a work group determines one of the five major concerns has been resolved, I recommend you revisit the survey data. Your work group can then pick the next concern to be addressed.

Periodic articles on survey-related actions will appear in *General Dynamics World*, as well as other communication vehicles at your division. And your division survey manager will be available to answer questions and assist you throughout your feedback and action planning process.



GENERAL DYNAMICS

World

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JACK NOBLE

Total quality management teams throughout General Dynamics are seeking continuous improvement of all company processes, such as part molding shown at Fort Worth Division. Molding to form parts for the F-16 Fighting Falcon eliminates the need to bolt small pieces together.

Weekly 'war room' conferences are shaping future of division

This story and the one on page six are the first in a series of case studies on total quality management at General Dynamics.

FORT WORTH DIVISION'S Michele Utech spends Thursdays in a workplace resembling a war room. She and 14 others alternately meet as a group, splinter into clusters or work individually on mind-boggling problems represented by complex

flow charts covering the walls.

The style is casual, both in talk and dress. Ties are loosened and shirtsleeves are rolled up. There is an underlying seriousness, however, because the employees know they are attacking deeply entrenched issues that affect the division's future.

Utech is a member of the supplier parts Critical (Continued on Page 6)

Pace to receive Forrestal Award

CHAIRMAN AND CHIEF EXECUTIVE Officer Stanley C. Pace has been named to receive the James Forrestal Memorial Award, given annually since 1954 by the National Security Industrial Association for maintaining close and continuous working relationships between government and industry in the interests of national security.

Past Forrestal winners include President Dwight D. Eisenhower, Gen. Alexander Haig, Sen. Barry Goldwater, Secretaries of Defense Frank Carlucci and Dave Packard and Lockheed Corp. Chairman and Chief Executive Officer Roy Anderson.

Pace, who will retire at the end of 1990, has spent 36

years in the defense industry. He worked for 31 years at TRW Inc., rising to vice chairman of the board. Pace joined General Dynamics as vice chairman in 1985 and became chairman and chief executive officer in January 1986.

The Forrestal Award is named for James Forrestal, who was secretary of the Navy during World War II and who later became the first secretary of defense. He was instrumental in founding the National Security Industrial Association in 1944. The association fosters effective working relationships and communication between government and industry in the interests of national security.

News Briefs

Employee survey results, calendar insert featured inside

This issue of *General Dynamics World* includes two extras: a section reporting results of the recent Survey of Employees, and the second in a series of calendar inserts.

The survey section contains charts that graph corporatewide employee responses and stories that analyze the results. Divisionwide responses will be published separately by each location.

First-place winners and runners-up from the recent employee photo contest are featured on the calendar insert folded inside. This insert contains calendars for March and April. The next insert will appear in the April issue of *General Dynamics World*.

Next cruise missile in works

Convair Division has begun an 18-month concept definition study of the next-generation cruise missile under a \$2.65 million contract recently awarded by the Navy.

The missile, called the Long Range Conventional Stand-Off Weapon, will be conventionally armed and can be launched from aircraft, ships and submarines. It is required to have extended range, improved navigation and terminal guidance, accuracy, low cost and compatibility with a variety of launch platforms. Weapon development is a joint Navy-Air Force program. The cruise missile is scheduled to start operation in the late 1990s.

Boeing, Martin Marietta, McDonnell Douglas and Texas Instruments also received concept definition contracts.

Pace elected; Hays honored

The Aerospace Industries Association has elected Chairman and Chief Executive Officer Stanley C. Pace as chairman of its board of governors. Pace will also serve on the association's executive committee.

Meanwhile, the late Herb C. Hays, a Fort Worth employee for 25 years, was posthumously honored by the Aerospace Industries Association and the National Security Industrial Association for his many years of service to both groups. Hays was credited for his contributions to the Aerospace Industries Association Quality Resources Study, which outlines key quality concerns for the aerospace and defense industries.

Robotic tank welding studied

An engineering team from Data Systems and Land Systems divisions recently established a robotic welding process for hull noses on M1A1 tanks by using a computer simulation.

Gary Pocisk from Data Systems and Jim Beste, Nick Saganowski and Mike Schaub from Land Systems performed the simulation on a robotic computer-aided-design workstation at the Lima, Ohio, Army Tank Plant. They created and modified a scale model of the proposed robotic work module and programmed various robot and positional movements to simulate hardware.

The foursome could determine the capabilities and limitations of the manufacturing operation and adjust appropriately.

The team approach to creating the simulation will be carried over to putting robotic hull nose welding into production. A study using the same approach has been started for a second hull station at Lima.

Current & Comment

A NEWLY APPOINTED Pacific Rim ambassador to the United States found himself in the headlines recently when he observed publicly that Americans have a habit of seeking to blame others for their own problems. That, of course, is the sort of offshore statement that brings its author instant popularity among news reporters, as was the case here.

However valid the ambassador's observation, it's certainly true that America has more than its share of problems today and it would be nice to lay the blame for each on someone else's doorstep. It's clear, however, that we cannot.

It's also clear that a lot of these problems have their roots in the apparent inability of America's schools, for whatever reason, to educate. The National Alliance of Business reports that the annual high school dropout rate is nearing one million, that seven of 10 who stay in high school can't write a basic letter seeking employment, and that three of five 20-year-olds can't add up their lunch bill.

Results of two nationwide studies released last month gave failing grades in basic reading and writing to more than 11,000 American children in 441 schools — an assessment virtually no different from that four years earlier.

In terms of economic loss alone, the impact is staggering. Remediation and lost productivity tote up to some \$25 billion annually, says the National Alliance of Business. And employers are spending an estimated \$210 billion for formal and informal training.

The consequences of a lagging academic system are being felt in all industries, especially those, like ours, which depend upon an available pipeline of engineers and scientists.

A year-end survey of 30 aerospace companies found that 67 percent reported current shortages of engineers and scientists — and 85 percent anticipated future shortages. The poll, by the Aerospace Industries Association, showed about half of the companies also had problems recruiting technicians and production workers — and that more than 80 percent forecast shortfalls.

Most disturbing among the association's findings was the fact that just not enough promising young students are opting for science and technology curricula — a field where American students just don't do well these days.

The Department of Education's Office of Educational Research and Improvement offers grim verification:

In arithmetic tests given to students of 20 countries, American eighth-graders finished 10th and Japan first. In algebra, U.S. students were 12th and Japan first. In advanced algebra, with 15 countries competing, our 12th-graders were 14th and Hong Kong was first. In geometry, U.S. 12th-graders were 12th and Hong Kong first.

In science, with 15 countries tested, American 10-year-olds were eighth while Japan and Korea tied for first. Among 17 nations, our 14-year-olds were 14th and Hungarian students were first.

Don't go away yet. In competition among 13 countries at the 12th-grade level, our students were 13th in biology and Singapore first; in chemistry we were 11th and Hong Kong first; in physics we ranked ninth and Hong Kong first.

Not really great news. But American industry is aware and counterattacking. This month, for example, hundreds of companies including General Dynamics are supporting National Engineers Week Feb. 18-24 with classroom teach-ins by professional engineers, technical exhibits and contests and other activities. Meanwhile, GD's array of educational programs across its divisions and subsidiaries continues to emphasize careers in computer and engineering sciences. Those who are volunteering their time and talents deserve our thanks and our help.

... PKC



Brian Frisbie installs rivets in the frame splice assembly of an MD-11. He is standing on what will become the passenger floor of the jetliner.

TIM WHITEHOUSE

MD-11's first flight signals speedup of fuselage production at Convair

THE FIRST FLIGHT OF THE McDonnell Douglas MD-11 jetliner on Jan. 10 kicked off a year that will see rapidly accelerating production at Convair Division, where the fuselage is made.

"In these days of tight defense spending, the MD-11 fuselage program is an important part of our business base," said John E. McSweeney, Convair general manager. "Right now our division business mix is about one-third commercial and two-thirds defense. In two years we expect that the fuselage production program will push that to 50-50."

Convair signed an agreement with McDonnell Douglas last March for production of the fuselage for the MD-11, which is built by Douglas Aircraft Co. in Long Beach, Calif. The agreement calls for 200 fuselages, with production expected to peak at around 50 shipsets per year by 1992. Total value of the program is expected to be \$2.4 billion.

This year, Convair will deliver 22 fuselages, up from

nine last year and five in 1988. The number of aircraft assemblers will double by the end of the year to support the production increase. Over \$10 million of rate tooling will be phased into the assembly line.

MD-11's worth to Convair

- ▶ Calls for initial production of 200 fuselages.
- ▶ Raises commercial share of business to 50 percent from one-third.
- ▶ Doubles the number of aircraft assemblers.
- ▶ Generates about \$2.4 billion.

The MD-11's maiden flight began at the Long Beach Airport near the Douglas plant and lasted approximately 2½ hours. The pilots were impressed with the handling capabilities of the new jetliner, according to Roy Gilmour, MD-11 program director at Convair, who was at the event. Certification is planned this fall.

MD-11 orders total 315 aircraft from 29 customers. The aircraft is available in three models — passenger, all-freighter and "combi," where passengers and freight are carried on the main deck. The MD-11 is 18.6 feet longer than the DC-10 trijet. Convair produced the fuselages for 387 DC-10s and 60 KC-10s, the Air Force tanker version, over 20 years. The last DC-10 was delivered in 1988.

■ Julie Andrews

Funding given for M1A2 pilot vehicles

LAND SYSTEMS DIVISION will fabricate five production pilot vehicles of the M1A2 Abrams tank as part of a funding award from the Department of Defense on Jan. 19.

The M1A2 will be an improved version of the M1 series in production at Land Systems since 1979. The M1A2 will include better armament, armor and electronics.

The \$55.5 million award exercises options under a full-scale development contract given in December 1988. The options include production planning for the M1A2.

"These actions will ensure a smooth and timely transition from full-scale engineering development to production," said Gordon England, Land Systems vice president-research and engineering.

Improvement in the tank's armor will increase chances of crews surviving in combat. Electronic sensors and systems will improve driving, target identifica-

tion and the passage of information between computer-driven subsystems, the crew and other tanks. A new radio unit will make possible transmission of digital data as well as voice messages.

The program will represent the first use of electronic data bus technology in combat vehicles. Subsystems will be connected by a data bus similar to that used in fighter aircraft. The commander, gunner and driver will operate new display systems.

"The continued evolution of the mature M1A1 makes possible cost-effective combat improvements that will enable tank crews to continue meeting worldwide threats projected for the 1990s and beyond," said Robert W. Truxell, Land Systems general manager.

The M1A2 will be developed at the division's Sterling Heights, Mich., facility. The division is scheduled to start deliveries of the new version in late 1992.

Corporatewide contributions stood at more than \$2.8 million last year

This is the first of three stories on contributions programs. The others will cover division- and employee-generated contributions.

GENERAL DYNAMICS' CORPORATE contributions department received more than 2,500 requests for grants in 1989. That volume indicates a high level of expectation by non-profit organizations across the nation, an expectation the company met by distributing more than \$2.8 million to charitable causes during the year.

With a budget nearing \$3 million — a figure that does not include the matching gifts program — General Dynamics' 3-year-old, four-person department operates much like a foundation while evaluating requests for cash grants. The staff also works with the corporate contributions committee to identify a series of innovative concepts for its corporate contributions to help selected non-profit organizations.

"The new concepts are something you really have to keep up with," said Win Gifford, corporate director-contributions. "If you don't, you can get left behind."

The contributions committee has established priorities for its contributions. Heading the list is education, followed by community needs, arts and culture, health care, youth groups, special military-related projects and public policy.

Funds for educational programs such as the National Merit Scholarship Corp., the United Negro College Fund and the University of Missouri-St. Louis' Access to Success make up 36 percent of the company's contributions.

A few of the philanthropic endeavors that once served only the community are benefiting the corporation as well. For instance, last year General Dynamics contributed \$60,000 to its Executive Liaison Program, which distributed up to \$2,000 to each

of 30 colleges it feels has the strongest engineering or finance curriculum. The money is used for counseling and placement needs such as office furniture and equipment.

"It's a developmental system that we believe strengthens the relationship between the university placement personnel and ourselves," Gifford said. "That increases the prospect that we'll be successful in recruiting the very best students."

"Fifteen or 20 years ago corporate charitable programs were geared almost entirely to benefit the community with virtually no benefit to the company. Under this new concept, we now are better able to hire some of the best students coming out of what we feel are the key schools."

More than 200 requests for contributions are fielded monthly by Gifford's office, many soliciting large sums of money. The strongest proposals are submitted to the contributions committee at quarterly meetings. The committee's choices are forwarded to Chairman and Chief Executive Officer Stanley C. Pace for review and approval.

The contributions committee also looks for model programs that might serve as an example for other organizations. One such recent contribution went to the Girl Scouts Council of St. Louis, which wanted to improve an outmoded computer system.

"They came up with an approach for some hardware and software they thought would make sense," Gifford said. "It was established that if it worked for the group in St. Louis, it could be replicated elsewhere. They asked us to help provide support with a matching challenge grant with another corporate donor."

"That's where we're really leveraging the impact of our money. The money will indirectly benefit other Girl Scout councils in other cities because of what we've done in St. Louis." ■ **Myron Holtzman**

1989 corporate contributions

Education	36 percent
Community	23 percent
Special military	14 percent
Arts and culture	10 percent
Health care	7 percent
Public policy	7 percent
Youth	3 percent

Key contributions

Education: Access to Success; Adopt-a-School; Consortium for Graduate Study in Management; National Action Council for Minorities in Engineering; Council for Advancement and Support of Education; United Negro College Fund; National Merit Scholarship Corp.; various universities and colleges.

Community: Alabama Space and Rocket Center; National Urban League; Dream Factory; Salvation Army; Hotels/Motels in Partnership Program; Anti-Defamation League of B'nai B'rith of San Diego; League of Women Voters; Museum of Science and Industry in Chicago.

Arts and culture: Old Globe Theater in San Diego; Arts and Education Council; Kennedy Center for Performing Arts; St. Louis Art Museum.

Youth: Boy/Girl Scouts of America; Boys Hope; Hugh O'Brien Youth Foundation; Junior Achievement; YMCA; Youth for Understanding.

Health care: American Foundation for AIDS; Family and Personal Support Centers; Association for Retarded Citizens in San Diego; Children's Hospital in Detroit; Leukemia Society of America.

Special projects: National Academy of Sciences; American Institute of Aeronautics and Astronautics; Armed Forces Monument Committee; Navy League of the United States; American Red Cross; Space Foundation; USO.

Public policy: American Enterprise Institute for Public Policy; Center for Strategic and International Studies; The Atlantic Council; Ethics Resource Center.

Corporate contributions committee

- Meets quarterly.
- Reviews and votes on an average of 50 major funding proposals from throughout the nation.
- Determines its decision on the basis of an evaluation of each request and a staff analysis by the contributions department.
- Funding recommendations are submitted to Chairman and Chief Executive Officer Stanley C. Pace for review and final approval.

Committee members:

Corporate Vice President and Chief Financial Officer James J. Cunnane; Executive Vice President-Missiles and Electronics Ralph E. Hawes*; Corporate Vice President-Communications Robert A. Morris, chairman; Corporate Vice President-Government Relations William H. L. Mullins; Corporate Vice President-Human Resources Arch H. Rambeau.

*Serves one-year alternating terms with Executive Vice President-Marine, Land Systems and International James R. Mellor.



Marilyn Damiecki

Heroic AMSEA engineer honored

A DETERMINED RESCUE EFFORT by Marilyn Damiecki, a second assistant engineer for General Dynamics' American Overseas Marine Corp., prevented further injury to a male cadet and earned maritime's most prestigious award.

Damiecki, who began working for General Dynamics Quincy Shipbuilding Division in 1982, serves aboard American Overseas Marine's *DeWayne T. Williams*, a Maritime Prepositioning Ship. A 1982 graduate of the Massachusetts Maritime Academy, Damiecki became the first woman officer to serve on a Maritime Prepositioning Ship two years later.

She and the cadet were working below decks on a bench grinder in the machine shop when the grinding stone sucked in the cadet's hand. After the cadet's hand was freed, Damiecki wrapped it and telephoned for help. When no one answered, she calmed the cadet and carried him over her shoulder up to the deck, where he was treated and transported to a hospital. Although he lost several fingers, the cadet has since returned to school, according to Damiecki.

"It was frightening," Damiecki said. "I don't know who was more frightened. But I felt it was important to keep him calm."

The rescue prompted officials to name Damiecki as the recipient of the Mariners' Rosette Award "for recognition of outstanding courage and devotion to duty." The award was presented during a recent dinner.

"I was honored to receive the award," said Damiecki, who was on a four-month assignment to Guam and Saipan at the time of the awards presentation. "After I received the award, I read about it in their publication. Before that, I had no idea how much the award meant."

Capt. B.J. Fennick, president of American Overseas Marine, accepted the award for Damiecki. "I am really proud of her," he said. "She deserved the award. Ms. Damiecki came to the aid of a fellow shipmate who sustained serious injury. Her quick actions saved a fellow seafarer from suffering even greater loss."

Fennick said Damiecki would have been allowed to return for the award presentation, but was too shy to do so. "She's bashful about everything — except her job," he said.

Correction

Doug Wilcox, the winner of Cessna's 1989 Community Service Award, was incorrectly identified in the January issue. *General Dynamics World* regrets the error.

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OUR FIRST SUBMARINE DID ONLY ONE REMARKABLE THING. IT CAME BACK UP.



John Holland invented the first submarine accepted by the U.S. Navy. Amazed reports said, "She goes like a fish and dives better than one."

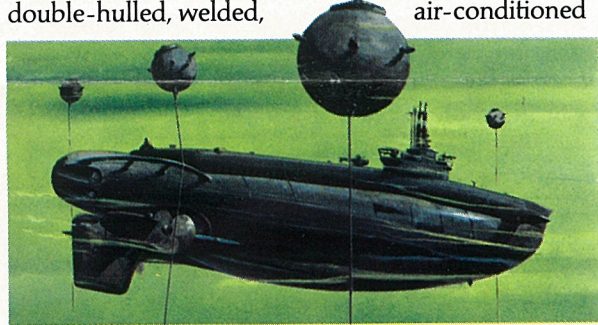
Squeezed into a crude, 14-foot craft, John P. Holland proved the basic principles of submarines in 1878.

His poetically named "Boat No. 1" was hauled to the Passaic River by 16 stallions for testing. It stuck in the mud, it leaked, but it came back up.

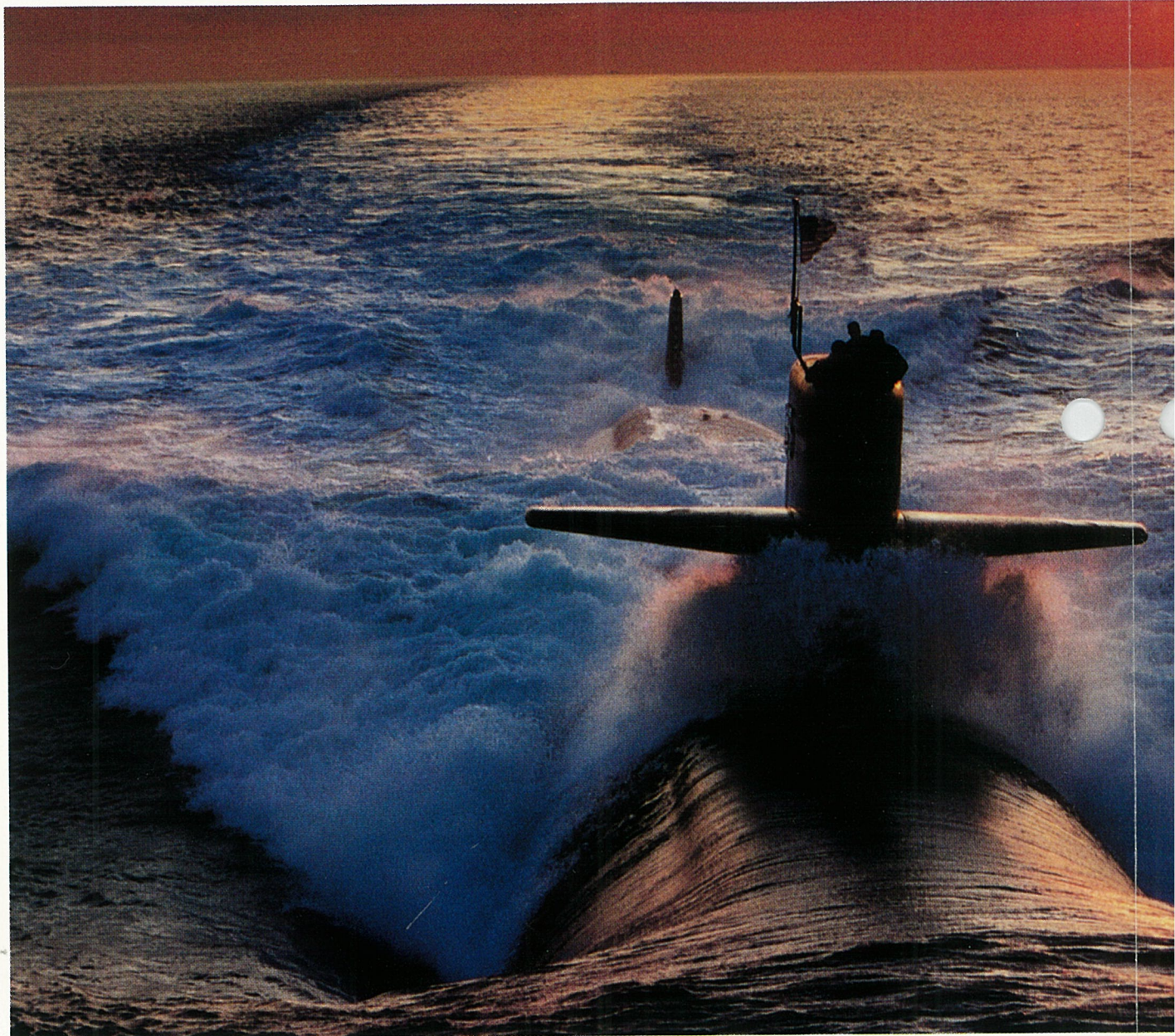
To us, the only thing more remarkable than the submarine itself was the courage of the submariner. Something that's still true today.

Holland got his Electric Boat Company, our earliest ancestor, off to a strong start in 1900, when the 74-ton submersible Holland became the U.S. Navy's first submarine. Showing his confidence in this new type vessel, President Theodore Roosevelt alarmed Secret Service bodyguards by taking an unscheduled dive aboard an A-class Plunger, August 26, 1905.

Running silent as well as deep became possible in 1933, when Electric Boat launched Cuttlefish, the first double-hulled, welded, air-conditioned



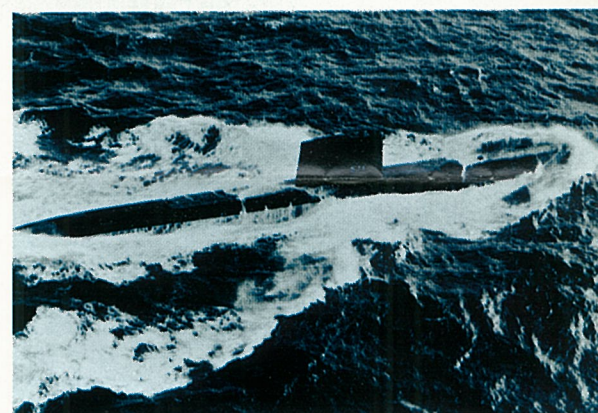
All WWII fleet submarines were based on Cuttlefish, the first submarine to be welded, rather than riveted, and a technical milestone.



submarine. She was the prototype for all WWII fleet submarines.

But it was on January 17, 1955, that we introduced the most dramatic improvement in submarines since John Holland and Boat No. 1. It was Nautilus, the world's first atom-powered vessel. And in an astonishing adventure, she became the first submarine to sail under the North Pole.

Today, our Tridents, the world's most advanced submarines, routinely patrol for 70 days without surfacing. Longer than the Washington Monument is tall, they are so carefully made that they cruise in virtual silence.



USS Nautilus was the first vessel to radio, "Underway on nuclear power." She then became the first to sail under the North Pole.

F-16 technology improves lives of the handicapped

ED PETRUSHKA SAID HE ALWAYS FELT that the same engineering technology that enhances the pilot's capabilities in the F-16 Fighting Falcon might someday be used to help the handicapped.

That's why the vice president-research and engineering at Fort Worth Division listened intently as John Staehlin spoke in Fort Worth about three years ago. Staehlin, founder of Volunteers for Medical Engineering, was in town to address the need for volunteers to create devices that would make life easier for the handicapped.

"What he said made an impression on me and it stayed with me," said Petrushka. "When I was promoted to vice president, I decided to do something about it."

What Petrushka did was form the Volunteers for Medical Engineering for Texas, a non-profit organization of engineers, technicians and aerospace industry professionals who use their skills to improve life for the handicapped through innovative technological solutions. He solicited Fort Worth engineers to donate their time to the organization.

"The response from volunteers was wonderful," Petrushka said. "We were on our way after that. We organized and incorporated our chapter in the state of Texas."

Today, there are some 250 members in the Texas group, including 150 employees from Fort Worth Division, according to Richard Cox, a project engineer at Fort Worth and chapter president. There are more than 600 members in the 11-chapter organization nationwide.

Sometimes the group solves major problems with a minor piece of equipment, such as an automatic door opener, a hands-free telephone or a fully electronic wheelchair.

"The techniques that enhance a pilot's skills might someday be used to help a handicapped person communicate with the outside world."

— Ed Petrushka

Others are a bit more difficult, such as a chin-operated learning device for a 10-year-old boy suffering from spastic quadriplegia caused by cerebral palsy. The condition, which made it difficult for the youngster to control his large muscle responses, had prevented him from communicating with others at his school. Three engineers from the flight simulation laboratory, Ron Thompson, Bryant Underwood and Rick Zimmerman, developed the device.

Last year, the chapter also helped a wheelchair athlete win recognition in bocce, a game similar to lawn bowling,

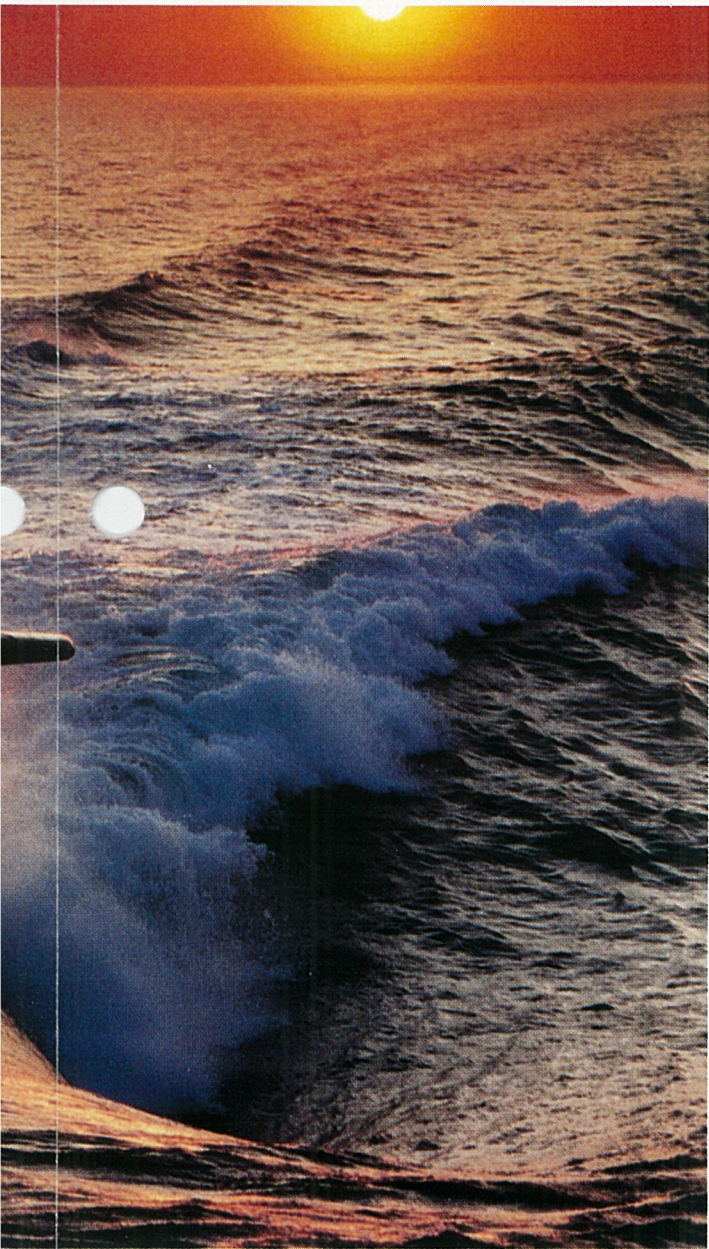
at the Paralympic Games in Seoul, South Korea. Most of the work on the project came from Fort Worth engineers Charles Kneezek, Tracy Rice, George Khoury, David Crowder, Ken Waugh and Kevin Zummo, who used the latest technology to devise a bocce ramp.

"Our engineers specially designed the ramp with high-tech, space-age design," Cox said. "Our athlete finished far ahead of the other competition." Unfortunately, the system was so advanced that it was disqualified. But there is a footnote. The design will be used in future competition when all contestants have an equal opportunity to use the device.

"We have a lot of fun with the projects," Cox said. "Working with the kids is the most fun, but sometimes we lose sight of the fact that adults have the same problems and we have to discover a solution for them as well."

Staehlin said projects have been proposed to his group not only by the Muscular Dystrophy and Multiple Sclerosis societies, but from doctors, hospitals and schools within the community as well.

"We listen to anyone's needs and then try to satisfy those needs," Staehlin said. Some solutions by Staehlin's group in Baltimore have been to design a tiny intercom switch alongside a paralyzed person's bed, developing a tiny invasive probe that radiates a tumor and measures and regulates its temperature, or designing a method for a paraplegic to control a computer cursor with the blink of an eye.



Yet innovations continue. Seawolf, a new class of submarine now under construction in our yards, will advance submarine science into the next century.

Seawolf re-proves two principles first proved by John Holland and Boat No. 1. That under deep water is found man's highest technology. And his highest courage.

Dedication to both has kept us improving American submarines for 90 years.

GENERAL DYNAMICS
A Strong Company For A Strong Country

Image ad campaign has new look

IN LATE FEBRUARY, the readers of America's major news, business and political publications will see the first in a new series of General Dynamics advertisements.

"These new ads represent an evolutionary step in our long-term efforts to put goodwill money in the bank for GD," said Chuck DeMund, corporate director-advertising and promotion.

"When we began our corporate image ad campaign in 1987, we were operating in a hostile environment," said Bob Morris, corporate vice president-communications. "Our corporate reputation was in disrepair and we were in the bull's eye of the media's target."

Wyse Advertising, the agency chosen to execute General Dynamics' first corporate image campaign in over a decade, recommended a subtle initial approach, focusing on "superordinate values"—images, symbols and ideas that are accepted by everyone.

"We were first concerned with creating a positive image and a common ground with our target audiences," said Michael Marino, co-president of Wyse. "Research showed it would have been counterproductive to show GD's products or to go into great detail about what GD is and what it does."

Wyse produced a successful series of ads that spoke of the company's involvement in a number of programs and projects, all of which illustrate that General Dynamics and its people value such concepts as patriotism, public service, help for the less fortunate and support of the democratic process. This careful approach was designed to "make people feel better about General Dynamics... and not know exactly why," Morris said.

The values approach worked well partly because of its surprise value. That a company in a then-maligned industry was actively involved in the fight against illiteracy, helping Special Olympians, rehabilitating prisoners, supporting public television and education, hiring and training Navajo workers and encouraging voter registration came as a surprise to many people. Thus the ads made a strong, positive impression.

Readership scores were universally high, sometimes topping all other ads in a publication. Opinion research shows that the company's reputation has improved significantly over the last two years. Consequently the element of surprise has diminished, reducing the effectiveness of the "values" campaign.

This led the agency to recommend a more focused approach, one that would not have been possible in 1987. "Our focus group testing indicates that both conservative and liberal audiences find history fasci-

nating and appealing, so we developed a series of new ads that show GD's products, but in a historical context," said Carl Camden, also a Wyse co-president.

The first of these new ads appears to the left of this story. By weaving General Dynamics' own contributions into the overall history of the submarine, this ad emphasizes the company's long heritage, its stability, innovativeness, technological achievements and its current role in, and potential contributions to, America's future. Other advertisements in development will deal with the company's part in the history of aviation, armored vehicles, the space program, etc.

The new ads have been tested with target groups in Los Angeles, San Diego, Chicago and Washington, D.C. The advertisements were well received in all cases, outscoring institutional ads from other corporations in and out of the defense industry.

Wyse developed a new look to catch the reader's eye and make the "history lessons" appear more interesting. A single large photo is supplemented by several smaller captioned pictures, giving the ads much the same look as a magazine article. The copy is lengthy, but tests indicate that audiences will read to the end.

The new campaign will run in *Time*, *U.S. News & World Report*, *Forbes*, *Fortune*, *Insight*, *National Journal*, *National Review*, *The New Republic*, *The Washington Monthly*, *Washington Journalism Review*, *Scientific American*, *Smithsonian*, *Air & Space*, *American Heritage*, Washington, D.C. editions of *National Geographic* and in selected trade publications. The ads will also appear in *The Wall Street Journal*, *The Washington Post*, *The Washington Times* and local newspapers in all division locations.

The campaign will appear in print and on radio. Radio versions of the ads will run on several Washington, D.C., stations in drive time and on sports programs. Rising costs have made television prohibitive.

"By speaking of General Dynamics' outstanding heritage as a defense supplier, these ads will remind our audience of the important role that the defense establishment and GD have played in maintaining our country's stature," Morris said. "Our research indicates that Americans desperately want to be reassured about America's strength. By invoking positive memories of 'the good old days' and relating them to the present, we feel that these ads will strengthen the image of our company and our industry to the benefit of all."

"As a result, we believe our target audience will now feel better about General Dynamics... but now they know why."

apped

► Ron Thompson of Fort Worth's flight simulation laboratory and occupational therapist Debbie Akins look on as instructor Beth Sturr (center) helps a cerebral palsy patient communicate with a chin switch developed by General Dynamics employees associated with Volunteers for Medical Engineering for Texas.

Staehlin said the projects became so numerous that he had to add two full-time staffers and enlist other aerospace industry volunteers. That's what prompted him to go on his speaking tour where he was heard by Petrushka.

"Our goal now is to develop programs that would affect a large segment of the disabled population," Petrushka said. "We've been doing things for the individual, which is great. But now we want to develop technology for a larger population."

"We're a high-tech firm, we build fighter planes, and we want to best apply the kind of technology we put into the F-16 cockpits into our VMET projects. After all, the techniques that enhance a pilot's skills might someday be used to help a handicapped person communicate with the outside world."

■ Myron Holtzman



TOM HARVEY

At Space Systems

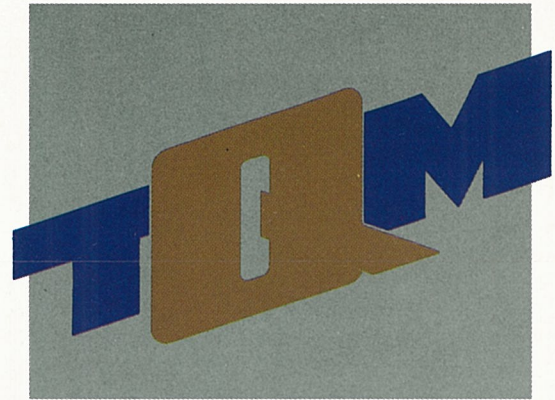
Team tackles errors in employees' time cards

REDUCING THE ERROR RATE on employee time cards sometimes seems as daunting a task as solving the homeless problem, according to a Space Systems process action team charged with the task.

Nine people from finance, production, engineering and quality assurance are assigned to determine changes needed to reduce the error rate within the five percent mandated by company and government policy. Members are Jennifer Roney, Nanc Anderson-

Metz, Carla Caira, Jasna Poljak, Nancy Michels and Bob Sweeney from finance, Andy Robertson from engineering, Kevin Jeras from quality assurance and C.J. Andrews from production.

The team originated as a pilot project in statistical process control applications for administrative problem-solving. Statistical process control tools — most often associated with the factory floor — are objective methods of measuring a process to determine whether



or not it is in control. After training in the methods, the team examined the processes producing the unacceptable error rate in the same way a manufacturing team would look at a quality deficiency in a piece of hardware.

In contrast to the factory, where manufacturing data is readily available, data for the team had to be collected over several months from regular audits. Applying statistical process control tools, the team began to organize the data, including a flow chart of the time card process, which involves over 70 steps in some cases. The team concluded that an error rate of 15 percent is predictable from the current system.

The audit showed the most common error was a time card not current for the day. The team turned to the employees — essentially the “customers” — to ask why. Large cause-and-effect diagrams went up in all plant locations asking employees to fill in the reasons for non-current time cards. The responses gave the team four key issues leading to four recommendations to the Space Systems finance staff.

The team recommended that another team be formed to tackle the No. 1 issue, too many work authorization documents. Issue two, too long to approve those documents, is expected to improve greatly with a new division cost performance measurement system that starts this year.

Issue three, removing the requirement that indirect-charging employees must fill out time cards, has been extensively reviewed. Issue four is the team's current focus: redesigning the time card employees say is too complex. ■ Julie Andrews



The team cutting time card errors includes (clockwise from lower left) Jasna Poljak, Bob Sweeney, Nanc Anderson-Metz, C.J. Andrews, Jennifer Roney and Nancy Michels.

TIM WHITEHOUSE

Fort Worth

(Continued from Page 1)

Process Team, one of 17 teams systematically working toward the total quality management goal of continuous improvement at Fort Worth.

The first three teams are addressing critical processes identified by General Manager Charles A. Anderson and his staff in a total quality management workshop last summer: the processes for obtaining parts from suppliers and for obtaining division-manufactured detail parts, both of which impact aircraft delivery schedules, and the travel authorization and expense report process, which affects everyone who travels on business.

The team working on travel has presented some recommendations to Carl Miller, vice president and controller, and to Fort Worth's Total Quality Management Steering Committee. Meanwhile, the detail parts team is investigating numerous items and is developing action plans.

While progress varies, the teams are using similar operational sequences and are encountering common problems.

The supplier parts team is representative of the others in many ways. Don Wren, director of division procurement, is the team “owner” or responsible manager. He supports the team and is authorized to make recommended changes.

The team members represent various departments — contracts, engineering, manufacturing, material operations, quality assurance, traffic and finance — responsible for obtaining parts from suppliers. The members selected Bob Griffin of quality assurance as chairman.

The team is working on the process for obtaining a particular part, the canopy actuator bell crank for F-16 Fighting Falcons, as an example of the division's entire procurement process.

Griffin said the team has spent most of its time defining the current process and collecting information. Future actions will include problem analysis, development of solutions and implementation of improvements.

Almost all the Critical Process Teams have found their tasks to be more time-consuming than originally expected.

“One of the big concerns is that team membership is like a second job — meanwhile, the members' regular work can pile up,” Griffin said. “Some members have expressed worry that their Critical Process Team work won't be considered in merit reviews for their regular jobs.”

Anderson eased some of these fears several weeks ago when he visited the team members and reaffirmed upper management's support for their activities and total quality management.

“The top level of management is sincerely committed to total quality management and the Critical Process Team concept,” said Bill O'Steen, a team adviser from

the division's total quality management department. “One of our major tasks is to ensure that mid- and first-level managers are equally committed.”

Other concerns expressed by some of the division's Critical Process Teams involve the level of support from their owners and the selection of appropriate team members, O'Steen said.

All of Fort Worth's team chairpersons meet monthly to share information. “We feel that effective communication is essential to ensuring the teams' success,” said Mike Whitchurch, another team adviser.

“All the teams realize the urgency with which results must be achieved and are dedicated to fine-tuning our business processes,” said G.I. Evans, manager of total quality management planning. ■ Joe Stout



Fort Worth employees (from left) Bill Potts, Dale Wolf, Bob Griffin, Tim Carne and Michele Utech discuss the process for obtaining supplier parts for the F-16 while teammates A.J. Baskin (left in background) and Willie Keith plot steps of the process on a flow chart.

TOM HARVEY



Electric Boat's Arthur Payne positions a house in a model that depicts Mystic, Conn., in the mid-19th century.

Electric Boat's Payne builds town with bare hands

CONNECTICUT'S MYSTIC SEAPORT Museum gives visitors a glimpse into the state's maritime history with its replica houses and tours aboard old wooden sailing vessels berthed along the Mystic River. One of the best introductions to the museum is through its full-scale model depicting the town of Mystic as it looked from 1850-75. Electric Boat Division's Arthur Payne is partly responsible for the successful exhibit.

Payne, a senior safety coordinator at the Groton shipyard who has worked in the safety department since 1975, moved to New England from Canada in 1958. He was initially hired by the Seaport to help a small group create the model to convey the omnipresence of shipping and shipbuilding up and down the Mystic River in the 19th century.

After almost three decades, the model began to show signs of aging. Payne returned to the Seaport in 1986, volunteering with two others to help restore and expand the project. He arrives early on Saturdays to put in a few uninterrupted hours before visitors come and ask questions.

Payne has become an expert on Mystic River history through his extensive research. Old photographs and

hand-drawn maps provided the basis for research when the model was first constructed. Old photos have sometimes clarified certain construction questions. That in itself presented a challenge.

"Photography was much less sophisticated many years ago and objects were foreshortened," Payne said. "We had to compensate for this in making the model to scale. Plus, in the case of the buildings, we had to distinguish between what the place actually looked like during the second half of the century and what details or additions had come later. It required a lot of cross-referencing among dated and undated photos and some detective work."

Payne carried his research into 19th-century homes to check internal details and the structure of attics, and to measure windows and mouldings. He has often created new ways to convey desired effects. House windows, for example, are etched with acetate, then filled with paint to look like mullions. Curtains are painted on the inside of the window with a thin wash to give the impression of cloth.

"People sometimes look at the model and ask me when the project will be finished," he said. "I tell them probably never. It's an ongoing thing, requiring con-

tinual research. I suppose we could reach a point where we'd say, 'OK, the model's done.' But I don't want to finish up. I like it too much."

The time spent carefully bringing the past to life is well worth the effort for Payne. "This model serves as a record of history," he said. "It's a tool for the museum to use, and as far as I'm aware, it's unique in terms of its scope and complexity. I don't know of another like it anywhere else in the country, so it's gratifying to be able to work on this project and leave behind something of significance."

One of the long-term plans for the model is to incorporate nearly 1,500 figures of animals and people bought from a company in West Germany to replace the figures now in the model. Payne will have to paint them by hand and position them in their proper surroundings.

"For me, the best way to view the model is to look up one of the streets with your eye right at street level," Payne said. "You feel as though you're right there in the scene; it takes you back in time." ■ **Graham Gavert**

Companies combine to develop NASP

GENERAL DYNAMICS AND THE other companies that had been working separately on the National Aero-Space Plane have teamed to develop the aircraft.

If the teaming arrangement is approved by the government, the members will design, build and fly the experimental plane, which would take off from a runway and fly directly to orbit. Other team members are McDonnell Douglas, the North American Aircraft division of Rockwell International, the Pratt & Whitney division of United Technologies and the Rocketdyne division of Rockwell International.

The team has been formed to combine and more

effectively use the best ideas and concepts for the aircraft. Rockwell's Barry Waldman has been named program director and is organizing a national program office. Personnel from all the team members will staff the office.

The group will be part of the national team headed by Robert Barthelemy of the National Aero-Space Plane Joint Program Office at Wright-Patterson Air Force Base, Ohio. The national team consists of the Department of Defense, NASA, industry, universities and national laboratories. The National Aero-Space Plane is scheduled to fly in the late 1990s.

Five employees honored

FIVE EMPLOYEES RECENTLY received awards in a new program begun by the Defense Contract Administration Services Plant Representative Office in San Diego.

The quarterly award, presented to those who most exemplify teamwork, leadership and integrity, went to: Kevin Epperson, contracts representative, advanced cruise missile program at Convair Division; Dennis M. Farness, quality control inspector, quality assurance, Tomahawk program at Convair; Al Pamintuan, Convair plant services; Richard Rico, quality assurance specialist, Space Systems; and Peter Masters, director of contracts, Electronics.

Members of the Defense Contract Administration Services office nominated the employees and voted to select the winners.

"We on the government side spend a lot of time telling you what you are doing wrong, but it's equally important to recognize that there are a lot of people doing a good job," said Air Force Col. E. C. Gassman, commander of the San Diego office.

Vital commercial launch part passes test

SPACE SYSTEMS DIVISION recently passed another milestone on its way to its first commercial space launch in June with the successful test of its new 14-foot-diameter payload fairing.

The aluminum fairing, which protects the payload from atmospheric friction and contamination during launch, was developed by Space Systems engineers to accommodate the larger satellites of the 1990s. The larger fairing will be used for the June liftoff of the Combined Release and Radiation Effects Satellite by an Atlas/Centaur launch vehicle.

The two-phase test took place in NASA's space power facility at its Plum Brook Station in Sandusky, Ohio. The facility is the world's largest space environment test chamber.

The test occurred at a simulated altitude of 85,000

feet inside the vacuum test chamber. Once the Atlas launch vehicle is above the earth's atmosphere, the payload fairing divides in two and is jettisoned.

The first phase tested the ability of the fairing to be jettisoned. The second phase tested the redundant dual actuator system.

"The test demonstrated the flight readiness of the new fairing," said Don Nirschl, director of test and evaluation for Space Systems. "What we proved is that we can lose one actuator but still jettison the fairing and maintain crucial clearance."

The fairing is built by the General Dynamics Services Co. facility at Harlingen, Texas. The fairing will be returned to Space Systems in San Diego to undergo structural tests.

■ **Julie Andrews**

Savings and Stock Investment Plans

	Annual Rate of Return for the 12 Month Period Ending:		
	Dec. 1987	Dec. 1988	Dec. 1989
Salaried			
Government Bonds	5.8%	7.1%	9.7%
Diversified Portfolio	6.7%	15.2%	32.4%
Fixed Income	11.4%	10.7%	10.3%
Hourly			
Government Bonds	5.9%	7.3%	9.9%
Diversified Portfolio	7.3%	15.5%	33.3%
Fixed Income	11.4%	10.6%	10.3%
GD Stock Closing Price	\$48.75	\$50.75	\$44.87

Grand openings

General Dynamics has several new facilities in operation around the country. This page highlights those at Fort Worth, East Camden, Ark., and Imperial, Calif.

FORT WORTH DIVISION'S Combined Arms Systems Engineering facility is ready for operation as a unique center to study future battles and related weapons requirements.

The 100,000-square-foot laboratory was built in 1988 with more than \$30 million in company funds to position General Dynamics for business opportunities in defense technology. The facility is highly secure with 47 television cameras and other safeguards.

The center recently won its first contract, an Air Force award to simulate operation of the Joint Surveillance Targeting Attack Radar System.

The project will primarily be conducted in the Battle Integration Center, a highly sophisticated simulation laboratory, according to George L. Davis, Fort Worth's vice president of the Combined Arms Systems Engineering facility.

Fort Worth fights battles without bruises

The Battle Integration Center, which began operation last summer, is the only facility in the United States where all facets of an air-land battle can be simulated and analyzed.

The center is being considered for joint battle doctrine evaluations planned by the Department of Defense. Davis said the center could also become an important U.S. asset for evaluating new defense strate-

gies in the changing world political climate.

The major elements of the center correspond to key components of modern battle. They include command rooms for blue (friendly) and red (enemy) forces, separate rooms for field commanders, and the main simulation control room, where large video screens show troop locations, aircraft and other assets, and where the "battle" occurs.

The center's red force is composed of General Dynamics employees who are well-trained in enemy strategy, tactics and force structure. The heart of the center is a complex computer network. System data bases contain detailed geographical information including roads, rivers and rail lines.

"We give both sides their assets and the computers fight the war," Davis said. "We postulate a scenario of the future world, and we can give the red force future weapons to use in fighting against our future weapons. It's limited only by the imagination and our ability to write specifications for future system performance."

"With this concept, we can focus on the difference that specific capabilities and equipment, such as candidate aircraft subsystems, will make in the outcome of a potential conflict. The center can be used as a tool to design future weapons systems that meet true operational requirements, to the benefit of the entire defense acquisition community."

In addition to military doctrinal evaluations and studies, the center will be used to support work involving all of the company's military product lines, Davis said.

■ Joe Stout



JACK NOBLE

◀ Locations and movements of troops and equipment are displayed electronically during a battle simulation at Fort Worth's Combined Arms Systems Engineering laboratory.

POMONA DIVISION HAS PREPARED the Highland Industrial Park facility in East Camden, Ark., to assemble and test Standard Missiles.

The facility will play a significant role in a new government-directed program to provide missiles assembled into "all-up rounds" — missiles complete with warheads and propulsion rockets — for the Navy. Previously, the division delivered the guidance and control systems and portions of the outer shells, and the Navy completed assembly.

Arkansas Gov. Bill Clinton was invited as guest speaker for the dedication ceremonies. Also invited were Rear Adm. George Meinig Jr., assistant deputy commander for Anti-air/Surface Warfare at Naval Sea Systems Command; Ralph Hawes, executive vice president-missiles, space and electronics; Pomona General Manager Sterling Starr; Capt. Richard Gilbert, commander of the Navy Plant Representative Office at Pomona; and other state and local elected leaders.

General Dynamics has leased, but not occupied, an area of Highland Park for several years. The area was expanded to include the new 27-acre multibuilding facility in July 1988. The facility is on the grounds of

Highland Park ready to assemble Standard rounds

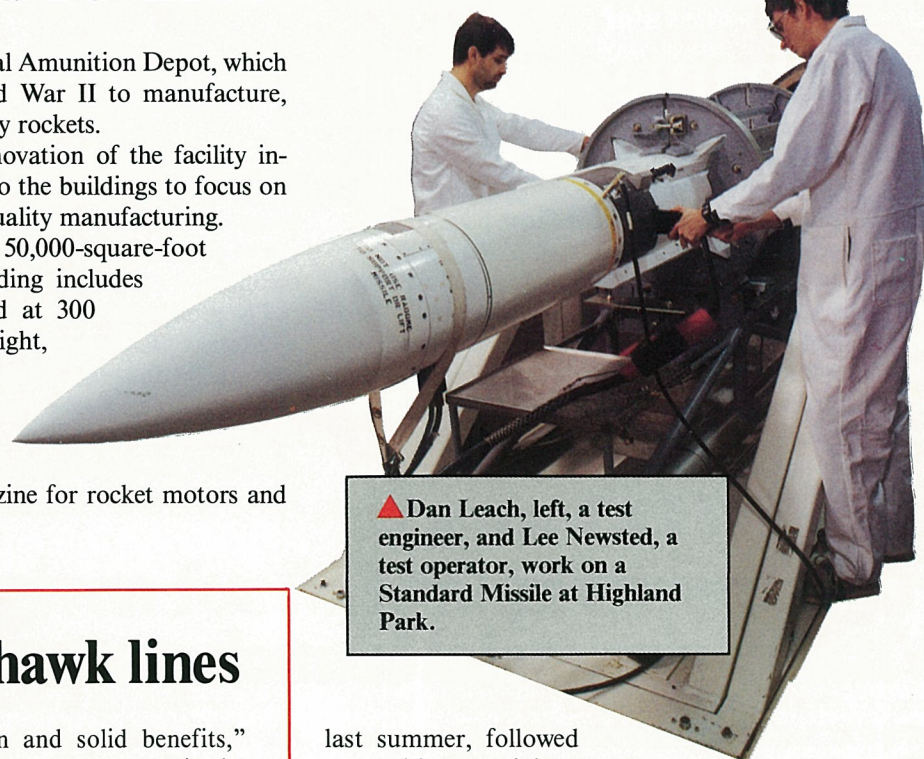
the former Shumaker Naval Ammunition Depot, which was opened during World War II to manufacture, store, test and rework Navy rockets.

Recently completed renovation of the facility included extensive changes to the buildings to focus on accident prevention and quality manufacturing.

New construction at the 50,000-square-foot main manufacturing building includes two test cells, each rated at 300 pounds net explosive weight, and a test control room that houses Pomona-made test equipment. A nearby building serves as a surface storage magazine for rocket motors and completed missiles.

The Highland Park facility will be operated by the company's Camden Operations. Ray Sabin is the facility's director and reports to Gordon Webster, Pomona Division vice president and general manager of Camden Operations.

Employees attended training sessions at the Naval Ordnance Station, Indian Head, Md.,



TOM RULE

▲ Dan Leach, left, a test engineer, and Lee Newsted, a test operator, work on a Standard Missile at Highland Park.

Imperial Valley set for MD-11, Tomahawk lines

THE FIRST GROUP OF EMPLOYEES at Convair's new Imperial Valley Facility in Imperial, Calif., has started training for production start-up of MD-11 fuselage and Tomahawk cruise missile components.

Convair announced last March that it would establish an off-site, light manufacturing facility in the Imperial Valley, about 100 miles east of San Diego. Ground was broken in August for a 65,000-square-foot building on a six-acre site leased for 10 years. Ken Rosevear was named plant manager in November. Production start-up is scheduled next month.

"For many of our employees, this is their first opportunity for good, steady employment with a company

that has a good reputation and solid benefits," Rosevear said. "Our employees are really enthusiastic, and we expect a high level of performance once the training phase is complete and production begins."

The Imperial Valley has had a high unemployment rate and an economy dependent on agriculture. Convair is the first aerospace company to locate there. Nearly all of the projected 150 employees and supervisors of the new facility will be hired from the Imperial Valley. San Diego personnel are conducting the training, which will include eight weeks in the classroom and several weeks of hands-on training in manufacturing processes.

last summer, followed by additional training at the Naval Ship Weapon System Engineering Station, Port Hueneme, Calif. Now certified, this group has been conducting training programs in East Camden as the work force is brought up to its planned strength.

Standard Missile is the primary surface-to-air guided missile for 137 U.S. Navy ships and 36 ships of nine allied nations. An all-electric, supersonic, tail-controlled anti-aircraft defense system, Standard features a modular design that eases compatibility, maintenance and logistics support. More than 19,000 Standard Missiles have been manufactured and delivered since 1966.

■ Eric Solander



Land Systems working to keep plants open

THE RECENT DEFENSE BUDGET sent to Congress by President Bush includes plans to end the M1 Abrams tank program and close the two Land Systems Division plants that make the tank.

Company officials hope to convince Congress otherwise.

Under the Defense Department plan, the Detroit Arsenal Tank Plant would close in September 1991 and the Lima, Ohio, Army Tank Plant would shut down in March 1993. "The focus in the Army with respect to tanks at this point then will be to move on and look at that next generation, the so-called 'Block III development,'" Secretary of Defense Dick Cheney said. "I think it's important in this case to shut down current procurement when we've got enough of a particular item and to focus the development long-term on the next generation tank."

If Land Systems is forced to suspend production, division officials will work closely with union representatives to make the transition as smooth as possible for employees. Specific details would be announced well ahead of time so workers can explore their options. The company will provide outplacement help for all employees, special skills training for new careers, and support for continuing education.

Meanwhile, Land Systems will try to persuade lawmakers to keep the plants open. The division has provided Congress with several counterpoints to the Defense Department's argument for closing the facilities:

- Suspension of tank production for four or five years would waste a national resource by eliminating the only tank-building capability in the United States. "If they close the tank plants, they eliminate an entire industry," said Robert W. Truxell, vice president and general manager of Land Systems.

(Continued on Page 2)

Land Systems Division officials and leaders of the United Auto Workers are trying to save the Detroit Arsenal Tank Plant (shown here) and the Lima, Ohio, Army Tank Plant.

MILT ST. ONGE

GENERAL DYNAMICS

World

Volume 20 Number 3

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European Stinger production closer

EUROPEAN PRODUCTION OF Valley Systems Division's Stinger anti-aircraft weapon moved a step closer recently with the acceptance of special test equipment from Valley Systems.

Dornier of West Germany, the prime contractor for the four-nation Stinger Project Group, accepted the first of 40 sets of equipment used to calibrate gold plate dual actuator assemblies.

The consortium consists of West Germany, the Netherlands, Greece and Turkey. The United States granted a license to the consortium in 1988 to produce Stinger in Europe.

Stinger has been in production at General Dynamics since 1979, first at Pomona Division and now at Valley Systems. In addition to the work for the consortium, the division has contracts with the U.S. Army Missile Command to produce more than 20,000 Stinger-RMP (Reprogrammable MicroProcessor) rounds through December 1991.

The division is fabricating and installing all of the test equipment required by the European partners. Valley Systems furnishes key missile hardware through

foreign military sales procedures and provides significant technical assistance to enable a timely start-up of consortium production.

Through a contractual agreement with the Army, the division has already received a license fee before start of European production.

During a recent demonstration and ceremony at Valley Systems Division, Klaus Frei, program manager-consortium test equipment, representing Dornier, accepted the first piece of equipment, a diode calibration test set.

The diode calibration test set as well as other pieces of equipment being made at Valley Systems will be installed at various production facilities in Europe. The first set has already been received by a consortium contractor in West Germany.

Other equipment being manufactured at Valley Systems includes missile and trainer hardware to help initiate the consortium's production line. These items will be shipped to European production sites later this year.

■ Jerry Littman

New controls pass tests aboard F-111

MODERNIZATION OF THE F-111 bomber fleet took a big step forward recently when an FB-111A aircraft modified with a General Dynamics-developed digital flight control system successfully completed its first phase of flight testing at Edwards Air Force Base, Calif.

Fort Worth Division built the General Dynamics-designed F-111 from 1962-76. The development and test program will eventually provide an upgraded flight control system for the entire Air Force F-111 fleet. The digital system will improve safety, reliability and maintainability when it replaces analog F-111 flight controls developed in the early 1960s.

The test aircraft logged 59 flights and 135 flying hours in the eight-month test program that began last June.

The aircraft is being modified with short wing tips to simulate the tactical version of the F-111. Testing is scheduled to resume in a few weeks and continue for six months.

GD, Mitsubishi OK start-up of FS-X program

GENERAL DYNAMICS AND Mitsubishi Heavy Industries have agreed to begin the FS-X program, which will develop a Japanese derivative of the F-16 Fighting Falcon.

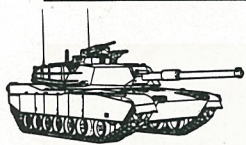
The FS-X co-design team will be led by Mitsubishi at its facilities in Nagoya, Japan. Engineers from other Japanese companies and General Dynamics will join Mitsubishi engineers at Nagoya within a few weeks. About 100 General Dynamics employees will work in the design at Nagoya and at Fort Worth Division.

Plans call for production of 120 aircraft. General Dynamics will handle three-quarters of U.S. industry's 40 percent work share in the FS-X. The company would probably receive half of the \$2-\$2.5 bil-

lion that would go to U.S. firms if the FS-X goes into production.

"We look forward to working with Mitsubishi Heavy Industries and the other Japanese and American companies to help make the program a success and the FS-X an outstanding aircraft," said Vernon Lee, Fort Worth's vice president-Japan.

The Japan Defense Agency selected the F-16 as the FS-X design baseline in October 1987 after considering a number of aircraft or building a fighter completely on its own. Under the agreement, Japan and the United States will share in each other's aircraft technology.



Plants

(Continued from Page 1)

"Resuming production at some future date would be difficult and very expensive."

- Idling the plants would force dispersal of a highly skilled work force, eliminate a significant manufacturing technology base and undermine an extensive vendor base. The plants have earned a reputation for quality. The Detroit plant recently was certified by the Army's Contractor Performance Certification Program, which recognizes defense contractors that consistently meet or exceed government standards for quality.
- The closings would dramatically affect the economies of Michigan, Ohio and Pennsylvania. Land Systems' tank production contributes an annual total of more than \$700 million per year to those states' economies.
- Suspension of tank production would eliminate the United States' ability to counter the future Soviet tank, the FST-2, in the mid-1990s. The action might also undermine efforts by U.S. negotiators to successfully conclude talks on the Conventional Forces in Europe treaty.
- The nearly \$2 billion cost of idling and restarting the Detroit and Lima plants, when added to the probable \$500 million to \$1 billion inefficiency costs associated with a newly trained but inexperienced work force, could be better spent keeping the lines open with reduced production of the new M1A2 Abrams. That amount could pay for about 30 tanks per month during the time the two plants would be closed. Land Systems currently builds about 60 M1A1 tanks a month.

Land Systems has several options to pursue:

- Division and United Auto Workers leaders will work closely with congressional delegations to keep the plants open.
- The division will do everything possible to generate additional international sales of Abrams tanks.
- The division will examine new product possibilities that might bring additional business to the plants. For example, Land Systems has teamed with foreign and domestic companies to compete for contracts to build a self-propelled artillery gun, an armored mine- and obstacle-clearing vehicle and a reconnaissance vehicle that can operate in the aftermath of nuclear, biological and chemical attacks. Land Systems is also pursuing development of a light tank called the Armored Gun System.

Sen. Carl Levin announced on Feb. 9 that Secretary of the Army Michael Stone had told him in a telephone conversation that the service had changed its mind about "laying away" the Detroit Arsenal Tank Plant in September 1991. The Army decided it would be a waste of money to relocate the machining operations from the Detroit plant when assembly shifts to Lima in 1991, according to Levin. However, the Army has not confirmed Levin's announcement.

Levin said the Department of the Army has decided to continue machining components at the Detroit plant as long as Land Systems builds tanks. Although Detroit assembly operations would be suspended, continued machining would maintain nearly 500 jobs at the Detroit plant.

■ Donald L. Gilleland

Current & Comment

Bully for the 'boomers'

TWICE A DAY, 3- to 5-foot tides sweep up and down Connecticut's Thames River, scouring the 30- to 40-foot channel from the New London Harbor up past the Gold Star Bridge and north to the Navy Submarine Base. Most days, from October to now — and even into April — the tidal run is accompanied by chill winds, fog, freezing rain or snow flurries. For those who spend their days by this river, building the big hitters of the U.S. Navy's sub fleet, the weather gets a lot of respect. If you're not careful, you'll find an ear or a finger or two seeking independence from the body. And when the sun does shine, it never really quite seems to warm you. In short, if you're into creature comforts, this isn't the place to winter over.

For about one fourth of the General Dynamics family, however, it's where the job is. At "The Boat." If you're accustomed to eating three meals a day and paying your dues on time to the local utilities and others, you get over to Groton early in the morning and help bring that next boat to her launch day. (Only outsiders call it a "ship" — or even call it by its given name such as the *Kentucky* or the *Alexandria*. Inside the gates, it's the '37 Boat (SSBN 737) or the '57 Boat (SSN 757).)

A lot of fathers, mothers, sons and daughters get their faces, feet and hands cold and dirty every day here. They hear a lot more noise than they'd like to hear, privacy is rare, and they need all of their senses in tip-top working order every minute. But they're back at it the next day, facing the awesome prospect of creating a complex, high-tech but safe and effective underwater home for some 150 highly trained submariners: putting together 8,000 tons of steel, 132 miles of cable and wire, 4,000+ valves, 80,000 fittings and so on. Pound for pound, in fact, it's almost impossible to compare the construction of a modern-day submarine with that of any other product in the world.

Maybe that's why Electric Boat has always carried a mystique that other companies don't have — and probably never will. Shipbuilding, especially New England shipbuilding, truly takes a special breed of person. Not just someone who can accommodate the whims of waterfront weather, but someone who can keep both eyes on the quality end product that will come, as indeed it does, from out of what sometimes appears to be organized chaos.

Ninety years ago next month, on April 11, the newly-founded Electric Boat delivered the Navy's first submarine, the *Holland*. One of Electric Boat's biggest boosters at that time was President Teddy Roosevelt who, to the undisguised dismay of his aides, actually spent three hours submerged off Oyster Bay, L.I., in another of EB's early-model submersibles. Roosevelt, a former assistant secretary of the Navy under McKinley, wrote to his boss of the *Holland's* "great possibilities for harbor defense." In 1901, Roosevelt urged Americans to build and maintain "a thoroughly efficient Navy," reminding them of the adage, "Speak softly and carry a big stick."

Almost a century later, Roosevelt's words appear prophetic. If ever a "big stick" has kept the peace and influenced the course of international politics, it has been the Navy's Trident "boomers" birthed on the banks of the Thames River. Few can now misinterpret the cumulative effect that a strong U.S. national security policy has had on Soviet strategy.

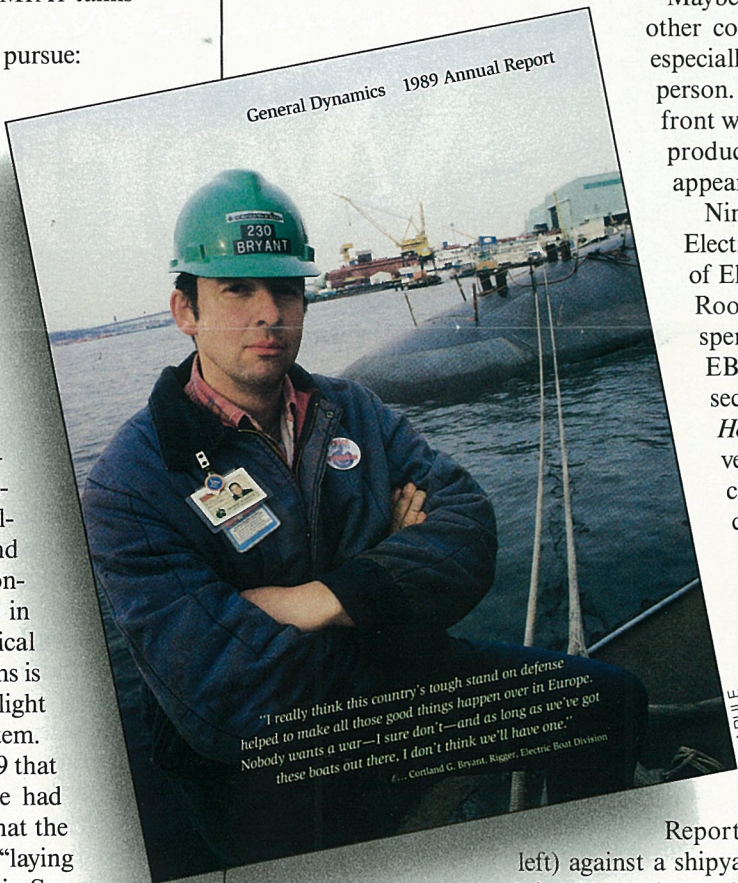
Cortland Bryant, a 37-year-old rigger and Niantic resident who's been working at EB since the summer of 1975, has this same message for readers of the 1989 General Dynamics Annual

Report, just off the presses. Featured on the report's cover (shown at

left) against a shipyard backdrop, Bryant says: "I really think this country's tough stand on defense helped to make all those good things happen over in Europe. Nobody wants a war — I sure don't — and as long as we've got these boats out there, I don't think we'll have one."

Teddy Roosevelt would have applauded.

... Peter K. Connolly



Volunteers help students pass the test

DAVE STOVALL AND Howard Williams teach a class daily at the Metro Opportunity School in the Fort Worth Independent School District. They are two of more than 60 Fort Worth Division employees who volunteer at the alternative school, which educates students who have been unsuccessful in regular settings.

The volunteers' time is well-spent. The school's principal, Gladys Pettid, credits them for helping improve scores on a state-required academic achievement test.

Students in all Texas schools are required to take the Texas Educational Assessment of Minimum Skills (TEAMS) test annually. "This fall, our juniors ranked third in the Fort Worth Independent School District (in TEAMS scores)," she said. "We also had 100 percent mastery of our seniors in language arts and only one senior who failed math. All students made tremendous gains from their pretest scores, gaining by as much as 30 points."

"I would like to thank General Dynamics for this tutoring program that has been so successful in increasing TEAMS scores at Metro."

Pettid specifically lauded the efforts of Williams and Stovall. Editorial group employee Williams teaches English. Engineer Stovall instructs students in mathematics.

Fort Worth also provides a large number of mentors and tutors who work with students individually to improve their academic skills, according to Norman Robbins, the division's manager-community relations. "A large part of the Metro adopt-a-school effort is aimed at improving the self-esteem of students," he said.

Pettid said the program enhances cooperation and school pride for students and faculty members alike. "Since all our students are at risk (of dropping out), the impact of this program to the community will result in more students graduating and becoming useful members of society," she said.

■ Joe Stout

GENERAL DYNAMICS

World

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Company and Machinists leaders meet



TOM RUIE

The leadership of the International Association of Machinists and Aerospace Workers met with company executives recently at the St. Louis Corporate Office. Talking things over are (from left) Ralph Hawes, General Dynamics executive vice president-missiles and electronics; Herb Rogers, General Dynamics president and chief operating officer; George Kourpias, Machinists international president; and Ed House, Machinists general vice president. Discussions with Rogers, Hawes and other top executives, including Chairman and Chief Executive Officer Stan Pace and Vice Chairman Bill Anders, covered the defense business environment, General Dynamics' prospects during the 1990s, and total quality management. "We came away very impressed with the amount of thought the Machinists have given to TQM — and we had a good opportunity to tell George and Ed about the issues the company faces," Rogers said. Added Kourpias: "It was a very productive meeting. We were pleased to meet with the company's top officials." The International Association of Machinists and Aerospace Workers is General Dynamics' largest union, representing about 23,000 employees.

Improved EM/OS comes on line

GENERAL DYNAMICS EMPLOYEES are using a new version of Electronic Mail/Office Systems as a result of a 14-month corporatwide major upgrade.

Planning for the upgrade began in fall 1988. Use of the improved system began last June at Electric Boat Division. The upgrade was completed in December with its installation at Fort Worth Division.

General Dynamics had been using a customized version of Digital Equipment Corp.'s ALL-IN-1 electronic mail software that increased capability as well as costs. Meanwhile, Digital Equipment recognized the value of the General Dynamics enhancements and incorporated many of them in its current ALL-IN-1 product.

This resulted in an agreement last March among all EM/OS sites to use the current ALL-IN-1 standard product to improve competitiveness and expand access to other systems. Using the standard product enabled the company to reduce the manpower that had been required for customization and support.

Improvements provided in the upgraded system include:

- Word processing. Easy bolding, underlining, page numbering and spell checking are provided by WPSPlus, the new full word-processing text editor.
- Indexing. By generating an index, an EM/OS user can act on more than one document at a time with a single command.
- Time management. This new feature is no

longer a prototype. Scheduling can now be coordinated through EM/OS.

These enhancements required documentation, training and increased hotline support. Even with the large cut in the program office documentation and training budget, divisions still devised ways to provide support. One major ALL-IN-1 improvement that helped this effort was new on-line training.

Users across the corporation received a variety of supports to smooth the transition. Individual divisions provided advanced training supported with reference cards and documentation. Help hotlines were operated with extra EM/OS experts from other divisions for the first week after conversion to answer additional calls.

No upgrade is completely free of problems. The two biggest ones were WPSPlus and some printer irregularities. Along with the full word-processing capabilities of WPSPlus came a necessity to understand its relationship to ALL-IN-1. This required a certain amount of user education. Printer problems came in many forms. Some were as simple to correct as educating the user while others required research and system changes.

One issue addressed by the users immediately after the upgrade was the way that ALL-IN-1 forces reading and printing of all addressees on every message and attachment. At the request of the users, the Corporate EM/OS Program Office immediately designed a User Setup option that allows the user to specify the way addressees are read and printed in each individual account.

AT&T to consolidate company network

GENERAL DYNAMICS AND American Telephone & Telegraph Co. have agreed on a multiyear, multimillion-dollar telecommunications network contract. AT&T will consolidate network services, equipment and management systems to replace existing voice, data and video network services provided to General Dynamics by various suppliers.

Implementation of the new General Dynamics Integrated Network has begun and is scheduled to be completed by July 1.

President and Chief Operating Officer Herbert F. Rogers and A.C. Stark Jr., AT&T senior vice president,

signed the agreements Feb. 14 following extensive negotiations.

A General Dynamics interdivisional team was formed a year ago to review requirements, develop a request for proposal, evaluate bid responses, and select a supplier. Network Equipment Technologies Federal, Inc., and Cincom Systems, Inc. will serve as subcontractors to AT&T in the competitively awarded contract.

This interdivisional project led by Data Systems Division is expected to save \$14 million over the three-year contract.

News Briefs

Sales hit \$10 billion; other financial results were mixed in 1989

A record \$10 billion in sales highlighted General Dynamics' financial performance in 1989. Earnings per share rose to \$7.01 from \$7.00 while net earnings declined to \$293.1 million from \$294.0 million.

Although operating earnings were up 12 percent over 1988, higher interest expenses reduced 1989 earnings per share by 56 cents. Increased company borrowing and the corresponding increase in interest resulted from changes during the 1980s in tax laws and Department of Defense procurement policies.

Fourth-quarter net earnings were \$82.8 million, or \$1.98 per share, on sales of \$2.6 billion. These figures compared to \$85.2 million, or \$2.03 per share, on sales of \$2.5 billion for the same period in 1988.

F-16 avionics earn incentives

The outstanding reliability of four F-16C/D avionics systems recently won more than \$9 million in Air Force performance incentives for General Dynamics and two subcontractors, Delco and Honeywell.

The Air Force paid the awards after the Fighting Falcon's enhanced fire control computer, advanced central interface unit, multifunction display and programmable display generator exceeded reliability targets set in the second part of a two-phased measurement program.

Fort Worth Division received almost \$5 million as the system designer of all four components and manufacturer of the advanced central interface unit built in the division's Electronic Manufacturing Center. This component exceeded its reliability target by 50 percent. Delco manufactures the enhanced fire control computer and Honeywell makes the multifunction display and programmable display generator.

Stiften elected controller

Edward J. Stiften has been elected staff vice president and corporate controller by General Dynamics' board of directors. Stiften will be responsible for consolidation accounting, external reporting, financial analysis and corporatwide accounting policies.

He will report to James J. Cunnane, corporate vice president and chief financial officer. Stiften, who had been corporate director-financial planning, has worked for General Dynamics since 1979.

GD seeks training contracts

General Dynamics' new Flight Training Systems Division is continuing work on two other military training programs following the Air Force's Feb. 21 award of its Tanker Transport Training System to a competing team led by McDonnell Douglas Corp. The Tanker Transport Training System calls for the purchase of up to 211 jets and associated training elements. Flight Training Systems and Cessna Aircraft Co. headed one of the runner-up teams.

Flight Training Systems is competing for the Joint Primary Aircraft Training Systems, which will replace the Air Force's T-37 trainer and the Navy's T-34 trainer, and the Bomber Fighter Training Systems to replace the Air Force's T-38 trainer. Flight Training Systems was formed in October to provide high quality military training.

Fort Worth pair rekindles Cajun ways, Texas style

JOHN FONTENOT AND Gerald Stout, Fort Worth employees who hail from Louisiana, have adopted a French motto for their personal efforts to preserve the Cajun culture: *Lache Pa La Patate*.

"It means don't let go of the potato, or hang in there," said Fontenot, who founded the Bon-Jour Texas Cajuns Club four years ago to promote Cajun culture and music. "We maintain a link with our past by getting together to reminisce about home and have a good time."

The club holds a picnic, or "rendezvous," each spring and fall, spending the day frying catfish, boiling crawfish and listening to traditional Cajun music played on an accordion, fiddle and guitar.

The first rendezvous in 1985 was attended by about 60 people. "At the latest one we had over 400," Fontenot said. "It's amazing to me how it has grown."

He said about 90 percent of the club's members are of Cajun descent, while the others just enjoy the music and culture.

Fontenot said the Cajun culture is being weakened and dispersed because of economic conditions in southern Louisiana, which have caused many Cajuns to move elsewhere, and because of past public school policies that discouraged use of the Cajun-French language.

Fontenot, an electronics technician, left Louisiana about 20 years ago. He has been with General Dynamics 16 years.

Stout, whose mother's name was Courville, is also an officer of the club. He moved to Fort Worth 17 years ago and works with Fontenot in the division's electronics design and development laboratory.

Fontenot said he knows of about 50 Fort Worth employees who are Cajun descendants or spouses of native Cajuns.

The Cajun people are descended from French immigrants who settled in Louisiana via Nova Scotia in the 1700s. ■ Joe Stout

Cessna will build largest service site for business jets

THE WORLD'S LARGEST FACILITY for servicing business jets will be built this year in Wichita, Kan., by Cessna Aircraft Co.

A \$10 million Citation Service Center will go up on 44 acres at Wichita's Mid-Continent Airport. It will be constructed next to Cessna's current Citation Service Center, which will be converted to an aircraft completion facility. The new center is expected to create at least 200 jobs at Cessna.

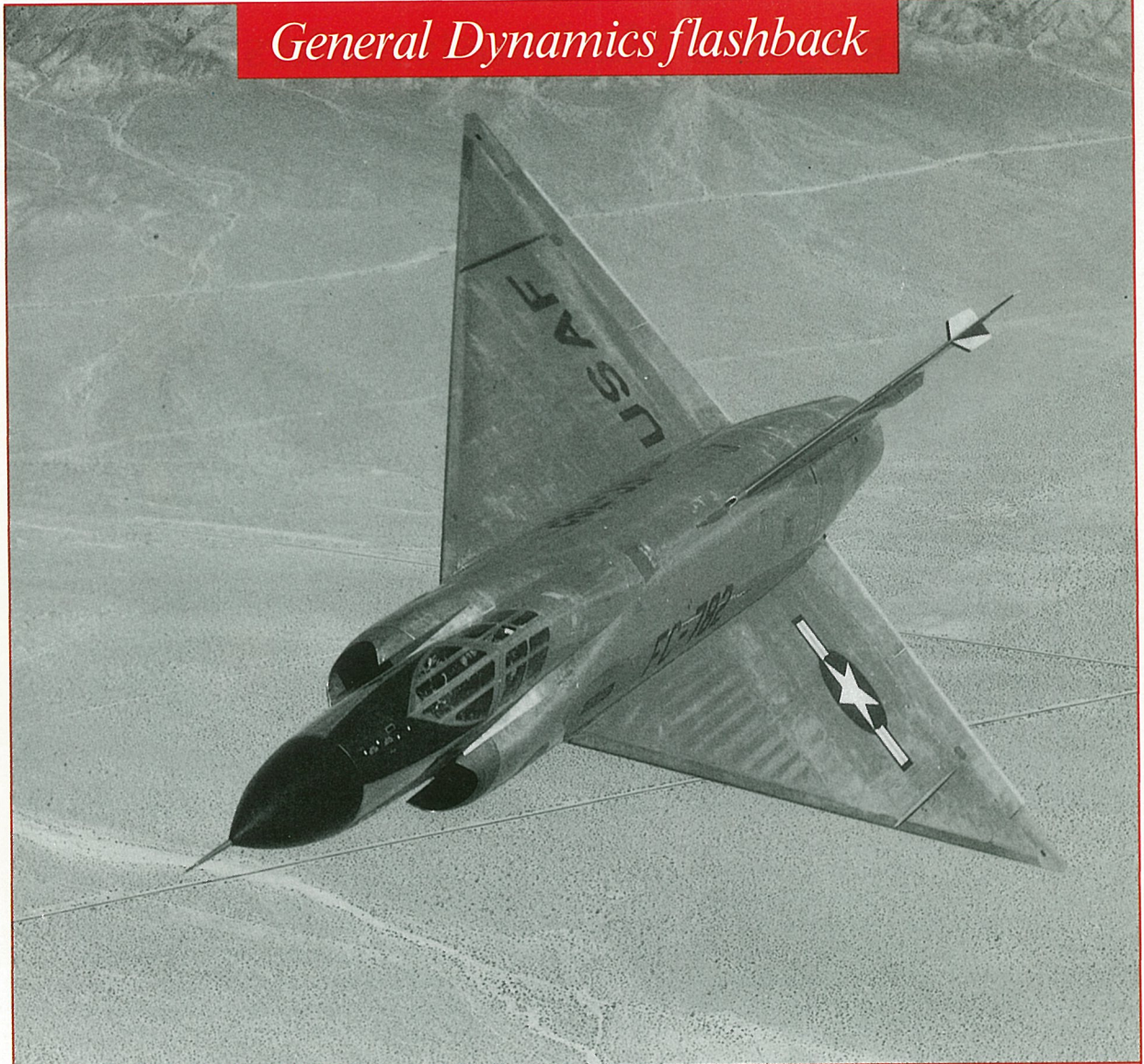
The operation will service Cessna's Citation business jets. Cessna is the only business jet manufacturer with factory-direct support through company-owned facilities. The new center will join five other Citation Service Centers in the United States and a sixth being built in Milwaukee.

Construction of the 161,800-square-foot structure will begin this spring. Completion is scheduled by the end of the year. The new center will be 30 percent larger than the present facility and will devote 111,800 square feet to hangar space. The facility will accommodate 27 aircraft for scheduled inspection and service and six planes for quick-response maintenance.

"The new service center will be capable of offering several types of service not available at the current center, including composite material repair, major avionics, electrical, mechanical and pneumatic component repair and overhaul," said Charles B. Johnson, Cessna vice president-product support.

Cessna's service centers are expanding with the Citation fleet, which is expected to grow from 1,600 aircraft to more than 2,000 by 1992 and 3,000 by the end of the 1990s.

General Dynamics flashback



Convair's delta-winged F-102 could intercept bombers day or night.

F-102 shielded U.S. from bombers

It was the world's first supersonic all-weather interceptor, the marvel of its day. Its advanced capabilities, greater speeds and ability to gain altitude in what became known as a "zoom climb" were unsurpassed.

Because the jet originally couldn't break the sound barrier, however, the F-102 Delta Dagger almost didn't get off the ground.

The Delta Dagger was a prime air defense weapon for the United States. With Convair Division as its prime contractor, the F-102 gained fame for not only its delta-wing design, but also as the first interceptor produced with no fixed guns, relying entirely on air-to-air missiles. It was also the forerunner of Convair's F-106 Delta Dart.

In 1951, the country was left almost undefended from air attack. Only a few obsolescent coastal radar installations and a few fighters were ready for emergencies.

The Russians' new TU-4 bomber, however, quickly altered thoughts of how to defend the country against intercontinental attack by high-performance aircraft. The call went out for the design of a new defense capability to intercept an intercontinental air attack.

Research already had begun. Convair started exploratory studies in 1945, eventually leading to the design of the delta-wing XF-92A. The concept of higher speeds by using a triangular wing was to make it easier for the plane to pass from just below to just above the speed of sound. The wing was strong and stable at high altitudes and could be made thin.

In 1949, the Air Force had hastily called an industrial conference, outlining the interceptor problems the United States soon would face. In 1951, competition was opened to design a new interceptor. In September, Convair's delta design was selected and designated the F-102. It included many advanced features. Its shape was one of the future, although its figure needed a little "tucking in."

Convair-San Diego's Plant II was selected for production.

The F-102 was the first plane to benefit from the heavy press program, which used extreme pressure to produce forgings for such parts as main wing spars. The new spars were lighter, but stronger than conventional spars assembled from sheet and extruded pieces. The plane also was the first to be built with Convair's Scotchweld process, which produced a wing with leak-proof fuel compartments. During the process, an adhesive material was placed between joining surfaces before riveting, then baked in a curing furnace to set the

material.

Because of time restraints, many other features couldn't be managed, and a lesser, interim program was substituted. This included a smaller engine and the Hughes MG-3 radar system. The radar could locate the target at long range, direct the pilot on a collision course and, at the proper moment, prepare and fire missiles or rockets automatically.

But early in its formulative stages, during wind-tunnel tests, the plane would not push past the speed of sound, threatening the program. Convair and Air Force engineers decided to apply the "area rule," a principle discovered by Richard T. Whitcomb, a research scientist with the National Advisory Committee for Aeronautics, in 1952.

The concept indicated that in slender, short-winged aircraft, the drag rise near the speed of sound depended primarily on the distribution of cross-sectional areas as measured along the plane's axis from nose to tail. In order to make up for the delta wing's relatively large wing, area had to be reduced near the wing to keep things in balance. Whitcomb found he could greatly reduce drag by indenting, or pinching, the plane's fuselage where the wings were largest; this prevented rapid change in the total cross-sectional area.

The plane, now called the F-102A and equipped with a Pratt & Whitney J-57 engine, was modified with its waist pinched along the wing, giving it a Coke-bottle appearance. Its nose was slimmed and lengthened and the canopy was streamlined. In addition, the plane was lightened by whittling away some of its excess structure.

On Dec. 20, 1954, the day after the first flight, the Delta Dagger easily surpassed the speed of sound, and full production was ordered by the Air Force. It was fitted with Hughes Falcon "homing missiles" and 2.75-inch folding-fin rockets. One or two larger nuclear GAR-11 missiles could replace the smaller Falcons, and two 230-gallon fuel tanks could be attached for ferry missions.

Now packed with the newest electronic gear, the Delta Dagger could intercept enemy bombers at any time of day or night. It could initiate the "zoom climb," arching up to 70,000 feet in the thin upper atmosphere to attack hostile aircraft.

First deliveries were made in June 1956, and by the time it was replaced by the F-106, some 1,300 Delta Daggers were delivered. The final F-102 came off the production line in April 1958. ■ Myron Holtzman

Division donations fit local needs

This is the second in a three-part series on contributions programs. The final segment will cover employee-generated contributions.

A TOUR OF THE CASA COLINA Hospital is a heart-rending experience. The Pomona, Calif., facility accepts only patients—including youngsters—who are rehabilitating from strokes and brain or spinal injuries.

Pomona and Valley Systems divisions have had a large effect on the hospital in the last several years. Pomona and Valley Systems contributed about \$16,000 in 1989 and employees have volunteered services to the hospital.

"We had taken a look at the operation because the hospital had treated some of the people from our division who had suffered strokes," said Pete Wylie, vice president of human resources and administrative services at Valley Systems. He is the latest in a succession of GD personnel to serve on the Casa Colina board of directors.

The enthusiasm Pomona and Valley Systems have for Casa Colina is an example of the diverse grant activities undertaken by the General Dynamics divisions and subsidiaries, which receive hundreds of contributions requests monthly. Land Systems, for example, has contributed to the Detroit Zoological Society, Electric Boat to Project Oceanology, and Fort Worth to the Arts Council of Fort Worth and Tarrant County.

"We recognize that in the communities in which we do business we have a responsibility to enhance the quality of life in different areas," said Neil Ruenzel, director-communications at Electric Boat. "We look to the organizations that have broad-based impact on our community."

One such organization helped by Electric Boat is the Thames Science Center. The center's RobotACTS project has interested many children in electricity and computers. It is even scheduled to make an appearance before a Congressional audience.

In addition to the almost \$3 million the Corporate Office contributes nationwide, 11 divisions/subsidiaries combined to bestow more than \$2.5 million including Cessna and Material Service Foundations' contributions, in 1989. More than 50 percent of the overall division budgets went to the United Way.

The divisions also equal personal donations to

accredited charities under the matching gifts program. Since 1986, the divisions' share in the program has more than doubled to approximately \$800,000 annually.

As in the corporate sector, most divisions rate education as the No. 1 priority. For example, San Diego strongly supports its Adopt-a-School program, which provides aid to a selected school, and Space Camp in Alabama. Meanwhile, Electric Boat has contributed to Robert E. Fitch High School to help with the school's library/media building fund.

Space Systems is also in its sixth year of producing a live television program in San Diego with astronauts and other space experts for the San Diego city and county schools. It is beamed by satellite throughout the country so that students elsewhere may participate.

"The communities are looking for us to be more responsive in terms of dollars and in terms of how quickly we can react to their requests," said Win Gifford, corporate director-contributions. "We want to be good representatives of the communities. That's one reason we instituted contingency contributions three years ago. The divisions need to have some money to be responsive in case there is an immediate community need—like the Hurricane Hugo disaster several months ago."

The contingency fund represents up to 15 percent of the divisions' budgets. Division authority to make independent grants, or contributions without corporate approval, has increased to \$1,500 from \$100 in 1987.

In San Diego, Convair, Data Systems-Western Center, Electronics and Space Systems share funding for organizations such as the Old Globe Theatre. Representatives from the four divisions meet monthly to identify organizations they want to support.

"Our focus in education is important not only financially, but in terms of our people getting involved," said Fred Bettinger, staff vice president-business communications. "Space Systems already has a volunteer program in place, while Convair is establishing the Volunteerism in Action program."

Several division grants have received national and international recognition. Convair supported 50th anniversary activities for the B-24 bomber last year with a major grant. The contribution meant a great deal to the community and to employees and retirees of Convair, where the plane was designed and built. The grant was widely publicized by the media.

■ Myron Holtzman

1989 division contributions

(Percentage spent in each area of contributions)*

Division	Education	Health Care	Community Support	United Way	Art & Culture	Youth	Contingency
Convair	10.9	1.2	11.6	53.2	8.4	1.8	13.0
Data Systems	21.2	8.7	9.3	40.5	3.0	2.9	14.4
Electric Boat	6.8	1.3	3.9	73.5	1.0	4.0	9.4
Electronics	10.4	5.7	7.7	51.9	4.5	4.6	15.1
Fort Worth	22.5	5.3	11.0	47.7	4.9	4.9	0.3
GDSC	16.9	12.6	38.0	5.7	2.1	13.6	10.9
Land Systems	5.3	5.5	24.6	40.5	7.7	6.1	11.0
Pomona	8.9	9.0	9.8	53.3	0.9	3.7	14.4
Space Systems	24.5	1.0	5.4	47.3	4.8	4.1	12.9
Valley Systems	11.7	22.1	0.2	51.9	0.6	2.3	11.1

*Cessna and Material Service make contributions through respective Foundations. Figures have been rounded off; therefore, some totals do not equal 100 percent.

Key contributions

Convair: B-24 Reunion; Old Globe Theatre; San Diego State University; Mexican and American Foundation.

Data Systems: DePortolo Middle School; William H. Backus Hospital; Junior Achievement; Regional Consortium Education Technology; Old Globe Theater.

Electric Boat: Thames Science Center; YWCA; Project Oceanology; Robert E. Fitch Senior High School; Child and Family Agency.

Electronics: Friends of the Library; Junior Achievement; Academic Decathlon; Mathematics, Engineering, Science Achievement; YMCA.

Fort Worth: Automatic & Robotics Research Institute; Fort Worth Aviation Heritage Museum; Cook-Fort Worth Children's Hospital; Arts Council of Fort Worth and Tarrant County; Salvation Army.

General Dynamics Services Co.: Confederate Air Force (Harlingen, Texas); Collegio Internacional de Carabobo-Venezuela; American Chamber of Commerce-Thailand; Maracay Cancer Society-Venezuela; Fe Y Alegria Orphanage-Venezuela.

Land Systems: Rehab Project; National Guard Association of Michigan; Boy Scouts of America; Lima Memorial/St. Rita's Hospital; Detroit Zoological Society.

Pomona: Casa Colina Hospital; Friends of Ganesha Park; California Vocational Industrial Clubs of America; Vocational Industrial Clubs of America National Committee; YMCA.

Space Systems: Association of Retarded Citizens; Space Camp; Hilltop High School/Knox Elementary; Mathematics, Engineering, Science Achievement; Hope Place of Huntsville, Ala.

Valley Systems: San Antonio Community Hospital; Vocational Industrial Clubs of America; Omar N. Bradley Scholarship and Education Fund; Mathematics, Engineering, Science Achievement; YMCA.



A statue of two soldiers operating a Valley Systems Division Stinger anti-aircraft weapon was recently dedicated at the main gate to Fort Bliss, Texas.

Stinger statue greets visitors to Fort Bliss

A STATUE DEPICTING Valley Systems Division's Stinger anti-aircraft weapon in action now greets all who enter the main gate at the sprawling Fort Bliss Army post near El Paso, Texas.

The bronze 9-foot, 7-inch statue standing on a 6-foot granite base replaces a Nike Ajax missile display that had occupied the site for more than 25 years.

The plaque affixed to the base of the statue reads: "Dedicated to Air Defenders, Past, Present and Future; First to Fire."

Fort Bliss is the home of the Army Air Defense Artillery Center where U.S. military personnel are trained to use the Stinger.

Stinger has been produced by General Dynamics since 1979, first at Pomona Division and now at Valley Systems. Over 20,000 Basic Stinger and Stinger-RMP (Reprogrammable MicroProcessor) missiles have been manufactured by General Dynamics. The system is fielded by all U.S. military services and several allied countries.

"How fitting that Fort Bliss at its main entrance will, from this day forward, have on duty two bronze Air Defense Artillery soldiers to greet and inspire those who come to our garrison," Maj. Gen. Donald M. Lionetti, commanding general of the Army Air Defense Artillery Center and Fort Bliss, said at the recent dedication of the statue.

Representing General Dynamics at the ceremony were Ralph Hawes, executive vice president-missiles and electronics; Mike Keel, Valley Systems general manager; Bill Leonard, program director-Stinger Weapon Systems; and Tom Moody, manager-Valley Systems Division El Paso office.

Two Fort Bliss soldiers, Staff Sgt. Alfred A. Jackson of Maryland and Spc. Gregory A. Bowman of Illinois, were selected to be the models for the statue because of their affiliation with a Stinger training battery.

The creative process began when the pair, accompanied by Michael D. Pike of the Fort Bliss Photo Lab, went to the nearby Hueco Mountains for a photo session.

Using a Stinger tracking head trainer, the soldiers performed search and scan and target detection procedures while Pike went to work with his camera. The finished photos were turned over to the artist, Steve Streadbeck of Utah, who sculpted the two Air Defense Artillery soldiers using the photos as his guide.

■ Jerry Littman

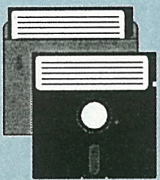
A reminder: Corporatewide meetings need OK

APPROVAL MUST BE OBTAINED for all corporatewide meetings. These are defined as meetings at which attendance is requested from all or most of General Dynamics' divisions.

An executive memo from Chairman and Chief Executive Officer Stanley C. Pace dated April 16, 1987, specifies that organizers of such meetings must submit a corporatewide meeting approval request to the chairman and chief executive officer or the president before the meeting is scheduled. Request forms are available by contacting Carol L. Miller, off-site meeting coordination specialist, at the Corporate Office. She can be reached on EM/OS or at (314) 889-8798.

Meeting attendees may also qualify for discounted air fares. Discounts are available for 10 or more people attending the same meeting. The attendees do not have to originate from the same location or travel together. Employees should identify to their travel office which meeting they are attending when making travel arrangements. This process will not impact the traveler beyond existing company travel policies and procedures.

Software conference set



Data Systems Division will serve as host for the fifth annual Corporate Software Technology Conference in San Diego May 16-18.

Papers are sought on Ada; object-oriented design; real-time systems; graphics; image processing; artificial intelligence; neural networks; distributed/parallel processing; and other unique approaches, applications or methods. Abstracts are due March 23.

Anyone interested in participating or attending should contact Conference Coordinator Diane Blankenburg or Assistant Conference Coordinator Claire Lopez by mail at 2299 Camino Del Rio South, San Diego, CA 92108-3605; by telephone at (619) 547-4555; or by EM/OS messages addressed to Sabuda,JD.

Contest II ready for filming



Planning is under way for "Photo Contest II," a sequel to the company's successful inaugural employee photo contest. Last year's event drew 715 entries. Twelve first-place winners and 36 runners-up received U.S.

Savings Bonds and are having their photos published in a calendar insert every other month in *General Dynamics World*. The 1990 deadline will be in early fall, so if you're planning to enter, this might be a good time to get out your camera and start shooting!



Fort Worth Division's Paul Ethridge has built the ultimate costume for his daughters Blair, 3, and Shannon, 10. Ethridge constructed the papier-mache F-16 Fighting Falcon as a Halloween outfit. It also doubled as a Christmas lawn decoration with Santa at the controls. Ethridge completed the plane with \$45 in material and 200 hours of labor. He equipped the plane with retractable landing gear, working landing gear doors and movable flaps. The F-16 comes complete with jet noise generated from a hidden tape player. Shannon "flew" the aircraft on Halloween while Blair dressed as a ground crew member. The costume won a contest at a local shopping mall. "We're thinking about going vertical next year — maybe a helicopter or a rocket," Ethridge said. He works as a quality assurance inspector on the F-16 assembly line.

Electronics certified a Class A firm

ELECTRONICS DIVISION JOINED AN exclusive club recently when it won a Class A material requirements planning award. The honor recognized improvements the division has made since starting the program. Material requirements planning stresses effective use of resources in production.

Electronics is one of only 55 firms in the United States to gain the honor. The division is the only defense contractor to win the award based on use of Department of Defense-specific software. Five other aerospace and defense companies have been selected as Class A manufacturers, but use commercial software.

Land Systems Division was certified Class A last year.

Electronics qualified after a long and rigorous audit by the Oliver Wight manufacturing management consulting organization, a leader in training for material

requirements planning. Electronics had to meet the demanding requirements of a 314-question survey.

The division celebrated with a presentation ceremony attended by more than 500 employees. Electronics General Manager Mel Barlow thanked the assembled crowd while accepting the award.

"Electronics' dedicated employees have made MRP a successful tool for the division," Barlow said. "We are more competitive because of what you have done with MRP. It's one of the many outstanding contributions made to continuously improve the division and to achieve our goal of being a world-class manufacturer."

A few of the major improvements include a 50 percent reduction in engineering changes; reduced production cycle times of 25 to 40 percent in major manufacturing areas; and purchased part shortages cut to 49 part numbers from 900.

■ Julie Andrews

Tomahawks cruise to operational record

THE TOMAHAWK CRUISE MISSILE broke a record recently with five successful operational test launches by the Navy in just eight days. Convair Division is one of the makers of the Tomahawk.

The third flight marked the initial successful test of the flex targeting system. Flex targeting permits the launch platform to change Tomahawk's target and flight path just before launch. The missile was launched from a destroyer off California and was recovered at the China Lake Naval Weapons Center, Calif.

The first and second flights took place over Maine on consecutive days. Both Tomahawks flew more than 700 nautical miles from launch to the recovery site at

the Navy Survival School near Rangeley, Maine. The Maine tests allowed the Navy to demonstrate Tomahawk performance in winter weather conditions.

During the fourth flight, the missile searched for and located a target hulk at sea. The Tomahawk simulated three attacks. It then flew to a recovery area on San Clemente Island off Southern California.

Unlike the previous four missions, the last missile was equipped with a live 1,000-pound warhead. The missile was launched from a destroyer in the Atlantic, searched for the target 200 miles away, and successfully attacked it.

■ Julie Andrews

Soviet officials tour Fort Worth facilities

A HIGH-RANKING DELEGATION of Soviet officials, including arms control, budget and military experts, recently was given a briefing on the F-16 program and a tour of Fort Worth Division's production facilities.

The 26-member delegation was headed by Vladimir Lapygin, chairman of the USSR Supreme Soviet Committee on Defense and State Security.

Rep. Les Aspin, chairman of the House Armed Services Committee, sponsored the trip to Fort Worth and to military bases and other facilities throughout the United States. Aspin and some of his colleagues visited the Soviet Union last year.

The visit marked the second Fort Worth tour by

Soviets within the last three months.

Charles A. Anderson, vice president and Fort Worth general manager, mentioned the first visit as he welcomed the latest group.

"We had a couple of top people from the Mikoyan Design Group then," Anderson said, referring to the manufacturers of the MiG series of jet fighters. "I think that General Dynamics and Mikoyan are the two best aircraft manufacturers in the world today. I know that General Dynamics definitely is."

Anderson's welcoming remarks and the F-16 briefing given by Dain M. Hancock, vice president of F-16 programs, were translated by a division engineer, Liza Wimberley, a native of Russia.

■ Joe Thornton

Savings and Stock Investment Plans

	Annual Rate of Return for the 12 Month Period Ending:		
	Jan. 1988	Jan. 1989	Jan. 1990
Salaried			
Government Bonds	6.6%	6.5%	8.8%
Diversified Portfolio	(3.7)%	20.7%	15.1%
Fixed Income	11.5%	10.6%	10.3%
Hourly			
Government Bonds	6.7%	6.6%	8.9%
Diversified Portfolio	(3.8)%	21.2%	15.5%
Fixed Income	11.5%	10.5%	10.4%
GD Stock Closing Price	\$52.25	\$51.25	\$40.62

() Denotes Negative Number

Electronics offers basic reading, writing classes

ELECTRONICS DIVISION IS MIDWAY through a 33-week pilot adult education program based on "English as a Second Language" offered through the Kearny Mesa Continuing Education Department of the San Diego Community College system.

The 20 employees enrolled in the course come to work early twice a week for classes in reading and writing specifically applied to their own workplace. The time is split evenly between employees and the company.

San Diego, like all of Southern California has a diverse population. The class includes native Americans and people from Mexico, the Philippines, Southeast Asia, Eastern Europe and South America.

"Because we have such a diverse work force, we wanted to institute a program that would help em-

ployees reach their full potential by improving their language skills," said John Wickersham, vice president-human resources.

The program was established last October and will run through June. Electronics provides instructors, course materials and a relaxed class setting. The employees provide self-motivation. The enrollees have already expressed positive feedback.

"We feel we are pioneers in establishing this program," said Bob Cosgrove, technical training specialist and program coordinator. "As far as I know, we are the only employer in San Diego offering a program like this, but I anticipate others will adopt similar programs with the growth of a multicultural work force and continued adult literacy concerns."

■ Julie Andrews

Egyptian visit more than a business trip

AFTER 10 YEARS AWAY from her native country, Electric Boat Division's Nadia Meseha returned to Egypt recently, but not on vacation. Rather, her participation in a special mission to assist the Egyptian Navy sent her home—a mission sponsored by the U.S. government and headed by Rear Adm. Walter H. Cantrell, Deputy Commander Submarine Directorate, Naval Sea Systems Command.

A small team of highly qualified technical specialists representing the command, Electric Boat, the Supervisor of Shipbuilding at Electric Boat in Groton, and the Naval Submarine Base upriver from the Connecticut shipyard convened to review and assess a program to add an upgraded combat system to four *Romeo*-class diesel submarines in the Egyptian fleet. The team had acquired expertise from many years of experience with similar upgrade programs to the four vessels stationed at the naval base in Alexandria.

While the team traveled to Egypt to serve largely in an advisory capacity, the mission carried a high level of diplomatic importance, requiring discretion and a concern for proper communication between the two nations.

"The team was tasked with reviewing all aspects of the upgrade and making a series of recommendations with an eye to the program's integrity, scheduling and cost," said Meseha, an engineer supporting command and control system engineering and integration for Electric Boat's Trident submarine program. "In addition to contributing on a technical level, I was there because of my upbringing in Egypt to help with any problems of interpretation."

Among the areas that were reviewed were interface design and software development; electronic test and integration; integrated logistics support; and connector assembly. The Egyptian navy's chief of arma-

ment thanked the American group by saying, "You have opened our eyes to technical issues that we were not aware of and we are grateful."

The trip coincided with Ramadan, a holy month in Egypt observed by strict fasting. "We were received with much hospitality by the Egyptian navy," Meseha said. "They arranged lunch for us every day even though the country fasts all day long until dark, and one of the naval attachés hosted the meals even though he couldn't eat a thing."

A last-minute change in travel plans allowed for a few hours of sightseeing in the Cairo area. The sights weren't new to Meseha, but intriguing nonetheless. "No matter how many times I've been to the pyramids, I've always felt the strangest feeling come over me when I stand inside the innermost chamber," Meseha said. "It's a completely enclosed cavity and it creates weird, indescribable feelings. I've never experienced this particular feeling anywhere else."

A highlight of the trip came when Rear Admiral Cantrell presented a photograph of a Trident submarine to the Egyptian hosts, "The words 'General Dynamics' were printed at the bottom of the photo," Meseha said, "and as he presented it, he pointed to those words and said: 'That's the company where Nadia works.' Stand-

ing there in my native country, yet being identified so completely with a symbol of my adopted country, I felt a real sense of patriotism for America. Possibly this is understood only by those who leave the country where they were brought up and make their home within another culture. Suddenly I felt a sense of belonging and that, in turn, made me feel proud."

■ Graham Gavert



Ethics program directors and hotline numbers

(* = hotline numbers)

NATIONWIDE

St. Louis—Kent Druyvesteyn 800-433-8442*

AMSEA/QUINCY

Quincy—James F. O'Hearn 617-786-8300 ext. 702

CESSNA

Wichita—Mark Bagley 316-946-7880*

CONVAIR

San Diego—John C. Barrons 619-573-8120*

CORPORATE OFFICE

St. Louis—Kent Druyvesteyn 314-889-8456*

Washington—Leland B. Bishop 703-553-1343*

DATA SYSTEMS

St. Louis—William E. Tucker 314-851-8906*

Camden—John Brown 501-574-4220

Fort Worth—D.G. (Dee) Chamberlain 817-762-7014*

Newport—Edwin A. Coolbaugh 401-848-8650

Norwich—James M. Cleary 203-823-2700*

Pomona—William E. Kirke 714-868-6620*

San Diego—John W. Withers 619-547-4682*

Sterling Heights—Carol J. Hussey 313-825-8629

ELECTRIC BOAT

Groton—William A. Miller 203-433-8000*

Avenel—Robert L. Wylie 201-636-0155*

Charleston—Cheryl A. Lyons 803-553-4850*

Quonset Point—Roland J. Plante 401-268-2705*

ELECTRONICS

San Diego—M. Ray Reynante 619-573-5384*

FORT WORTH

Fort Worth—John L. (Jack) Shultz 817-777-1400*

Abilene—Jon A. Cohen 915-691-2131*

FREEMAN UNITED COAL

Marion—James T. Ryan 800-637-0399*

GD SERVICES

St. Louis—Doris Chiste 314-851-8997*

LAND SYSTEMS

Detroit—Charles J. Stieber 313-825-5888*

Lima—Thomas E. Ansley 419-221-8555*

Scranton—Richard W. Gray 717-876-5797*

MATERIAL SERVICE/ MARBLEHEAD LIME

Chicago—Edward K. Wilverding 800-225-0926*

POMONA

Pomona—Roy E. Harris 714-868-2001*

Camden—Mike Crutchfield 501-574-4446*

SPACE SYSTEMS

San Diego—Alda O. Jorgenson 619-573-8367*

Cocoa Beach—Howard F. Biegler 407-730-0185*

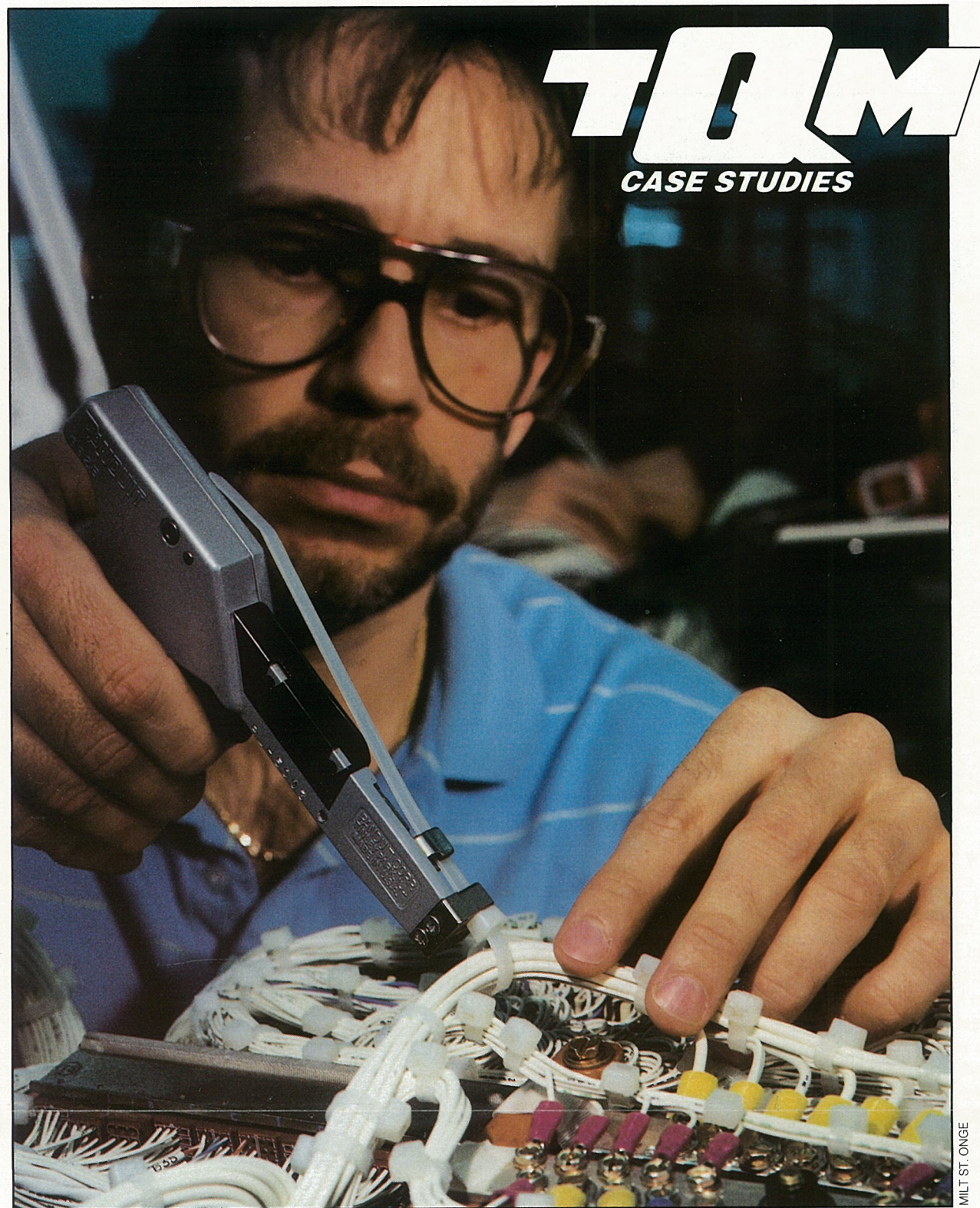
Vandenberg AFB—Ray Degen 805-865-8072*

VALLEY SYSTEMS

Rancho Cucamonga—

Bill Coleman 714-945-7772*

◀ Although Electric Boat Division's Nadia Meseha grew up in Egypt, this was her first camel ride. "At Electric Boat, co-workers often joke that 'Nadia is off parking her camel,' so I thought it was about time I tried it," she said.



Rick Milkie, an electrical assembler at the Sterling Manufacturing Plant, fastens a cable bundle in the turret network box using the new one-step cable strap gun process.

Land Systems harnesses quality

A MALFUNCTION IN THE TURRET network box of an M1A1 Abrams tank can cripple the vehicle. The box channels electricity to all turret assemblies much as a circuit breaker distributes power to all of a home's electrical outlets.

That made the work of a total quality management team at Land Systems Division's Sterling Heights, Mich., Manufacturing Plant doubly important. The nine-person team improved the cable harness assembly process for the network box and greatly reduced the chance of total turret electrical failure.

The new process will go into widespread use in April.

In the old process, cable bundles were hand-tied with lacing cord every three quarters of an inch and trimmed. Each of the 460 individual ties in the turret network box was then coated with spar varnish.

In the new process, cable bundles in the turret network box are held together with nylon cable straps that are tightened and trimmed in one step with a cable strap gun. The ties need to be applied only every 2 inches and do not require a varnish seal.

The new process improves quality, reduces physical strain, helps the environment and reduces costs.

Some of the benefits:

- Reduces cable trunk separation and abrasion points, which can result in total turret electrical failure, by 50 percent.
- Eliminates missing spot ties.
- Eliminates varnishing of spot ties.
- Reduces the number of spot ties required per turret network box by 62 percent.
- Reduces assembly time.
- Adapts to all similar wire bundling applications.
- Eliminates storage and disposal of spar varnish, a hazardous material.
- Improves assembler work environment.

- Reduces the pressure on assembler hand, wrist, and finger movement.

"This new process is great," said Rick Milkie, an electrical assembler. "It's easier, cleaner, less tiring and cost-effective."

The team members from the affected manufacturing and quality organizations started their investigation last September after a high occurrence of missing and unvarnished spot ties.

The team analyzed the harness process to identify all associated problems, determined potential solutions, built a sample unit with the new process, materials, tools and equipment, and presented their findings and recommendations to management.

Sterling management presented the team's new process and findings to the Defense Contract Administration Services, the government agency responsible for product acceptance at the plant.

The agency then evaluated a turret network box assembled with the new process against environmental requirements such as withstanding hot and cold temperatures, shock, vibration, fungus, mildew and humidity. The test verified the team's findings and recommendations, resulting in the new process being cleared for use.

"The new cable harness assembly process significantly improves the quality and cost competitiveness of the M1A1 configured turret network box," said Richard O. Gillette, Sterling Manufacturing Plant manager. "The process has similar potential for all cable harness assemblies in the tank."

"This improvement realized through the initiative of our quality-conscious employees is representative of their commitment to continuous product improvement."

■ Karl Oskoian

Valley Systems team slashes time to get repair parts

REDUCING AND ULTIMATELY eliminating delays in servicing and repairing equipment are typical of the total quality management actions under way at Valley Systems Division.

One of 70 teams formed to solve problems and improve processes, the machine repair/service team tracked the time needed for written requests to be answered with emergency purchase order parts. The time between request and receipt can be costly, especially on a production line.

The team used a seven-step process being taught to Valley Systems employees in two-day total quality management training sessions:

1. Describe an operation.
2. Form a team.
3. Analyze the process.
4. Define and use short-term improvements.
5. Define and use long-term improvements.
6. Evaluate effectiveness.
7. Institutionalize improvements.

Item 1 was satisfied by tracking the time for requests to be filled by an emergency purchase order part.

To satisfy item 2, the team was formed with Ron Carpenter from procurement; Jerry Kober and Will Mieras, facilities maintenance; Mac Silverthorn, facilities warehouse and stores; and Tom Thielo, facilities planning and design. Thielo served as team coordinator by arranging meetings and sharing information. Dick Hadinger, director-facility plans and services, and Kevin Daugherty, manager-facilities planning and design, were "co-champions" of the team. "Champions" provide resources and eliminate roadblocks encountered by the team. Other employees, including Carol Jarvis from the machine shop and Jim Hoffman from financial planning, acted as consultants to the team.

To fulfill item 3, the team generated a flowchart that identified five root causes of delays.

Unlike quality circles, which generally can only recommend solutions, Valley Systems' total quality management teams are empowered to devise and try solutions. The machine repair/service team came up with five short-term improvements:

- Buying pagers for maintenance personnel to expedite responses.
- Examining an increase in the authorized petty cash limit for machine repair part purchases.
- Increasing the authorized limit for supervisor approval.
- Examining elimination of the repeat signature cycle between the purchase order requisition and purchase order on-line system.
- Setting up blanket purchase orders with electrical and plumbing shops to allow maintenance personnel direct and immediate contact for faster responses.

The team will monitor the process to verify the results of the improvements and to determine any long-term actions.

Travel's destination is to cut approvals

A PILOT PROJECT TO IMPROVE travel authorization is the first result of teams working on total quality management issues at Fort Worth Division.

The project will use electronic mail and will eliminate many approval steps in the current process. The new system is scheduled to start in the third quarter of this year after completing computer programming. A decision on broad use of the process will be made after the pilot project ends.

The proposal came from one of about 20 groups called Critical Process Teams dealing with total quality management at the division. Employees who recommended the new authorization process are members of the travel Critical Process Team. They briefed Carl Miller, Fort Worth's vice president and controller who is the designated "owner" of the process, and the division's Total Quality Management Steering Committee, which then OK'd the pilot project.

GD team's ATF prototype set for first flight June 30

THE PROTOTYPE OF the Advanced Tactical Fighter being developed by the team of General Dynamics, Lockheed and Boeing is scheduled for its first flight June 30.

Designated the YF-22A, the aircraft is a candidate for the Air Force's next-generation fighter. A version of the Advanced Tactical Fighter has also been proposed for the Navy.

The YF-22A prototype is being assembled at Palmdale, Calif., from components produced by all three companies, said D. Randall Kent, Fort Worth Division vice president and Advanced Tactical Fighter program director.

The development team recently completed its third successful avionics demonstration at Boeing's Seattle facility, according to Sherm Mullin, Lockheed vice president and general manager of the Advanced Tactical Fighter team program office at Palmdale.

"This is the most advanced set of integrated avionics and software that has ever been demonstrated in the United States," Mullin said. "This demonstration is another piece of evidence that our team will be ready for full-scale development on schedule."

The aircraft's forward fuselage was moved to Palmdale from Lockheed's Burbank, Calif., facility in December. The tails arrived at Palmdale from Fort Worth the same month. Fort Worth shipped the center fuselage to Palmdale in January, about a week before Boeing shipped the aft fuselage from Seattle.

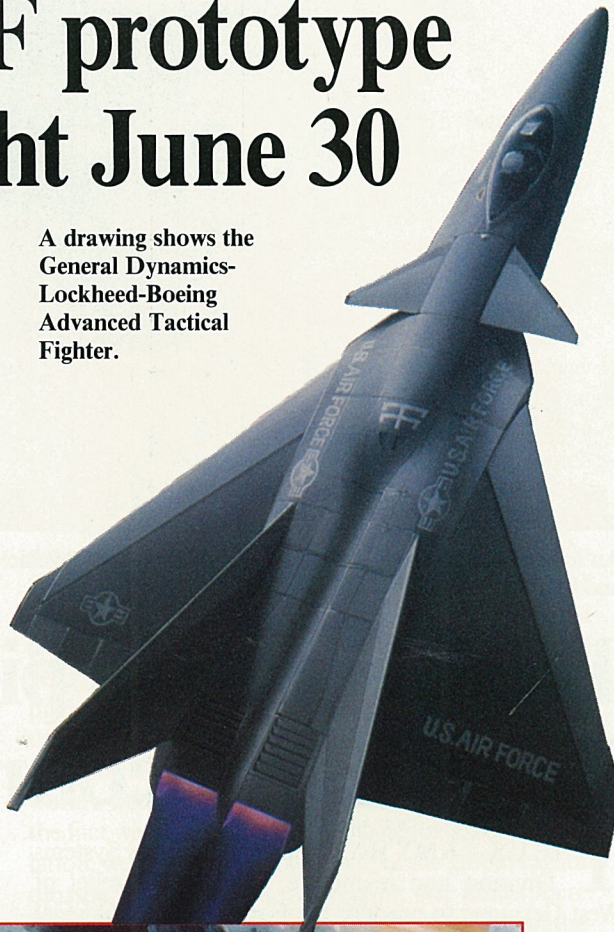
Dave Ferguson, Lockheed's Advanced Tactical Fighter project pilot, has been preparing for the first flight by flying a handling qualities simulator in Fort Worth's Flight Simulation Facility.

Mullin said the Advanced Tactical Fighter will be the most self-sufficient fighter ever produced in the United States. "We're on the road to making it twice as reliable as current-generation fighters," he said.

The Lockheed-led team is competing against the team of Northrop and McDonnell Douglas. Each team is developing two prototypes, one to carry each of the two competing engines.

The Air Force plans to announce the competition

A drawing shows the General Dynamics-Lockheed-Boeing Advanced Tactical Fighter.



The proposed Navy version

winner on May 1, 1991, and award its full-scale development contract a month later. The full-scale development aircraft is planned to fly for the first time in July 1994.

Congress cut \$200 million out of the Advanced Tactical Fighter's fiscal 1990 budget late last year. However, the Air Force is considering restoring full contractual funding.

Forrestal winner Pace praises U.S. stand

"I accept this award not as an individual, but as a member of a very large team." With these words Chairman and Chief Executive Officer Stanley C. Pace accepted the James Forrestal Memorial Award March 22 and paid tribute to a generation of Americans who, "ever since the end of World War II, have been willing to carry the burden of supporting freedom and self-determination in a difficult and polarized world."

Speaking to an audience of about 900 industry and government executives in Washington, Pace added that "45 years later, these ideas and these efforts have triumphed."

Pace joined a select group of people who have received the Forrestal Award from the National Security Industrial Association. The honor has been given annually since 1954 for maintaining close and continuous working relationships between government and industry in the interests of national security. Other winners include President Dwight D. Eisenhower, Sen. Barry Goldwater and Lockheed Corp. Chairman and Chief Executive Officer Roy Anderson.

In his Forrestal Award acceptance speech, Pace inter-

(Continued on Page 3)



Stanley C. Pace addresses the audience after accepting the James Forrestal Memorial Award.

News Briefs

Booklet inside marks Earth Day's 20th; calendar included

Readers of *General Dynamics World* will find two bonuses folded inside page eight: a booklet marking the 20th anniversary of Earth Day, and calendars for May and June.

Earth Day, first organized in 1970, will be April 22. The booklet describes General Dynamics' efforts to protect the environment and offers conservation tips for individuals.

The calendar is illustrated with first-place and runner-up shots from the recent employee photo contest. The next calendar, for July and August, will appear in the June issue of *General Dynamics World*.

Scranton Plant rated Class A

Land Systems Division's Scranton, Pa., Plant has received a Class A manufacturing resource planning award.

Class A is the top certification for effective use of all resources needed for production. Oliver Wight Cos., a private firm specializing in corporate resource planning and scheduling, made the award.

The Scranton Plant is the fourth Land Systems facility to be certified Class A. The Central Office Complex, the Detroit Arsenal Tank Plant and the Sterling Manufacturing Plant are the others. In addition, Electronics Division was recently certified Class A.

Council 'knights' Barrons

John C. Barrons, Convair Division's ethics program director and manager of community relations and equal employment opportunity, has been named 1989 Gold Knight of Management by the San Diego National Management Association Council. It is the highest honor from an areawide council.

The award is presented annually to an executive who excels in management, community service and National Management Association support.

Turk is model F-16 fan

Emin Findikli, a photographer with the Turkish Television Network and a model hobbyist, has created a special display that he enjoys showing to the Turkish public.

Findikli used components of old toys, an F-16 model kit and other parts to build a 1/12th-scale F-16 cockpit with working controls and displays. The result is a miniature simulator.

"F-16 visibility is very high in Turkey and there is a great demand for F-16-related items," said Jack Burlin, a Fort Worth program development employee who met Findikli at a trade show in Ankara, Turkey.

Car-buyers get price break

General Dynamics employees can purchase cars from Hertz Corp. at discounts up to \$1,500 in April.

Hertz will hold a nationwide sale for employees of corporate clients such as General Dynamics on April 27, 28 and 29. The cars are 1989 and 1990 models that were part of Hertz's rental fleet.

Sales locations, admissions credentials and other information are available at all General Dynamics human resources offices.

Convair contracted to develop guidance for standoff weapons

CONVAIR DIVISION HAS WON a \$14 million, three-year contract to develop and test an advanced laser radar, or ladar, guidance system for standoff weapons. Known as ATLAS — Advanced Technology Ladar System — the program builds on guidance programs in work at Convair since the early 1980s.

In 1984 Convair won the Cruise Missile Advanced Guidance program, a five-year contract to demonstrate a full guidance system that would provide higher accuracy and simplified mission planning for the Tomahawk cruise missile. ATLAS will move closer to implementation by incorporating all experimental Cruise Missile Advanced Guidance-proven technology into a near-prototype that will be extensively tested.

ATLAS enables the missile to navigate to a known target area and acquire, precisely locate and attack the target. ATLAS is a strong contender for the guidance system of the Long Range Conventional Standoff Weapon, a next-generation cruise missile to be developed jointly by the Navy and Air Force.

Convair was recently awarded a \$2.65 million contract for an 18-month Long Range Conventional Standoff Weapon concept definition study. The weapon will be a conventionally armed system with extended range, improved navigation and terminal guidance, accuracy, low cost and compatibility with a variety of launch platforms.

A successful ATLAS program relies on key technologies such as the carbon dioxide laser radar built by Hughes and high performance computing and image processing in development at Convair. The program is sponsored by the Air Force Armament Lab and the joint Air Force/Navy Long Range Conventional Standoff Weapon program.

Surprise visits are healthy happenings at Valley Systems

VALLEY SYSTEMS EMPLOYEES never know when their division's executive safety and health board might show up.

The board and Kevin Waszak, manager-safety and health, make four unannounced tours annually through portions of the division. The tour's route is known only to Waszak until the board is briefed in General Manager Mike Keel's office.

The surprise visits are an important part of the division's efforts to promote job-related safety and health. The tours are successful because "we have been able to take corrective actions that contribute to improvement," Waszak said. The actions include engineering and administrative controls and protective equipment use.

Waszak selects areas to tour based on potential occupancy hazards, employee accident data and new or changing department safety procedures. He briefs safety board members on specifics to check.

"One of the most important aspects of the quarterly tours is the opportunity the board has to talk to individual employees and to find out what they believe is needed to continue to maintain a safe working environment," Waszak said.

■ Jerry Littman



An improved version of the West German army's Fox vehicle (above) will be developed by Land Systems Division and Thyssen Henschel for the U.S. Army.

Land Systems picked to produce Fox NBC reconnaissance vehicle

THE U.S. ARMY HAS SELECTED Land Systems Division and teammate Thyssen Henschel of West Germany to produce the Fox Nuclear, Biological and Chemical Reconnaissance System vehicle. Contracts totaling nearly \$31 million were awarded to Land Systems and Thyssen Henschel on March 15.

The Fox is a wheeled, armored, amphibious vehicle that will be used to conduct rapid reconnaissance on the battlefield to identify and communicate the presence of contaminants.

The contracts call for improvement of the existing Fox system built by Thyssen Henschel for the West German army, and initial production of eight interim systems — with options for an additional 40 vehicles.

"The Fox Nuclear, Biological, Chemical Reconnaissance System is the only operational system of its kind in the Free World," said Jurgen Massmann, a member of the executive board of Thyssen Henschel. "The existing system provides a strong baseline for evolutionary improvements with low technical risks."

A team led by TRW and including General Motors competed with Land Systems and Thyssen Henschel for the contract. The Fox award is a boost for Land Systems. The future of its only major production program, the M1 Abrams tank, is threatened by cuts in the defense budget.

"Winning this contract against a team as strong as TRW and General Motors has provided a lift in morale as well as providing a new vehicle platform for Land Systems Division," said John Petty, Fox program manager for Land Systems.

Full-rate production of 210 Fox vehicles for the U.S. Army will be built at Land Systems' facilities in the Detroit area beginning in 1994. The program could lead to the production and support of up to 600 vehicles worth more than \$1 billion over 10 years.

Two more for Land Systems

Land Systems received two contracts totaling \$25 million in March in addition to the Fox award.

The division will demonstrate a system to improve the survivability of combat vehicles under a \$12 million contract from the Defense Advanced Research Projects Agency and the Department of Energy. The second award assigns Land Systems to develop a heavy assault bridge system for the Army Troop Support Command.

Vehicle survivability work will include live-fire tests during a two-phase, 30-month program. Land Systems will use innovative technology that could substantially reduce vehicle weight. The concept is based on a patent to John Wohler, vehicle survivability project manager, and on an electronic processor developed by Greg Dorr, vetronics. Both are Land Systems employees.

The bridge system is manufactured by MAN Gutehoffnungshutte of West Germany and will be mounted on two Abrams tank chassis built by Land Systems. The bridge will cross 80-foot gaps. The demonstrator vehicles will be developed during the next 19 months, then begin 13 months of tests. The Army will compete a production contract following completion of a final technical data package.

Bahrain becomes 16th nation to fly F-16s

BAHRAIN'S AIR FORCE received its first Fighting Falcon in ceremonies at Fort Worth Division March 22. The dual-seat F-16D was accepted by Col. Ahmed bin Sulman Al-Khalifa, assistant chief of staff of the country's defense force.

Bahrain ordered 12 F-16s in March 1987. The aircraft are the latest Block 40 version, powered by the General Electric F110 engine. Four of the aircraft will be F-16Ds. Eight will be single-seat F-16Cs.

Nearly 50 members of the Bahrain air force were present at the ceremony. They have been receiving F-16-related training at Fort Worth and other U.S. facilities since May 1989.

Bahrain is the 16th nation to receive F-16s. No more new countries are scheduled to receive the aircraft. But several nations have placed follow-on orders and some



The first F-16D Fighting Falcon delivered to Bahrain's air force flies over north Texas.

other countries are considering Fighting Falcon purchases.

Bahrain is the first country to operate the F-16 in the gulf region of the Middle East.

GENERAL DYNAMICS

World

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Current & Comment

That 'E' word

- The red import up ahead looks like it's laying down submunitions on the freeway. An aluminum "empty," then another, fly out of the driver's window and bounce along the roadside. Two polystyrene all-beef-patty cartons follow, whipping along in the car's slipstream and looking for a spot to spend their next 340 or so years.

- In the Midwest, a big-tree bounty hunter with a pocketful of blank checks from a California manufacturer prowls the back roads of farming communities, searching for scarce black walnut trees destined to become high-priced furniture and flooring.

- A world congress of biologists in England compares notes to discover that frogs are literally vanishing from ponds, lakes and forests all over the world. No one is sure just why, but the evidence in hand points to man's encroachment into their habitat.

- Is that thermometer right? Yes. The five hottest years of the entire 20th century were — no surprise — during the 1980s. The two hottest years on record were 1987 and 1988.

- In the northern Pacific, west of Seattle and the Strait of Juan De Fuca, cruise ships encounter drift nets more than 100 miles long — indiscriminate floating death for the thousands of ocean creatures unfortunate enough to stray into the narrow mesh.

- Heard about the perfectly preserved 1971 Thanksgiving ham exhumed from 20 feet down in a New York City landfill? Wrapped in a perfectly readable November 1971 New York City newspaper after almost 20 years? So much for decomposition.

It's 1990, we're at war, and the enemy is us.

At a time when the world's political, economic and social foundations are rocking, let's not put the big "E" — the Environment — on the back burner. The truth of the matter is that it's the one thing we can do something about. And unless we do, it's not beyond the imagination that our children, or their children or grandchildren, won't even have time to worry about other things like freedom and justice for all.

Is that too farfetched a notion? In fact, is this whole eco-scenario, including the Earth Day 1990 phenomenon (see insert in this issue of *General Dynamics World*), only some well-orchestrated hype by a coalition of fringe groups aided and abetted by some slick PR and the support of a lot of well-meaning private groups and big business?

The answer is no. Not just no, but you-can-bet-your-biosphere no. But wouldn't it be an easy way out for everyone if that were true? We could sneer at car pools and hit the highways alone each morning with a gloriously clear conscience. We could switch on that air conditioning unit at the slightest discomfort and we could use all the aerosol aids our poor deprived pores crave. We could buy any plastic-packaged products we wanted and happily carry it all home in an even bigger plastic bag. We could cut down any tree or bush that didn't seem to fit into the aesthetics of our home landscaping. And we could pitch all that glass, aluminum and newspaper into the garbage can without a second thought.

If you read that to say that Americans are the world's worst polluters, you're reading it right. Despite the fact we represent only 1/20th of the world's population, we account for one-fourth of the global carbon dioxide buildup that's overheating our atmosphere. Worse, our affluence has given most of us an apathetic mind-set. "It's bad," we say to ourselves. "Something has to be done and maybe next week I'll do it."

Actually, most of these things we could do will not only help preserve the planet for those yet to arrive, but can save us a few bucks. So, for no other reason than being economical, why not look for ways to reduce your use of fossil fuel energies and save dwindling resources? You can find a few suggestions in the environmental insert in this issue.

A word of caution. Earth-keeping can be not only habit-forming, but beneficial to your health.

...Peter K. Connolly

Environmentalists share data, ideas at all-division event

REPRESENTATIVES FROM throughout the company exchanged data on research and engineering activities that could benefit the environment at a workshop in Fort Worth April 3-6.

The event was the All Division Technology Exchange Workshop on Environmental Resource Management Issues. The theme was "Environmental Health and Safety for Current and New Materials and Processes."

Fort Worth gave presentations on a number of pilot projects planned or under way. These include a chromium process rinse water recycle system, a paint overspray detackifier process, a waterborne maskant system and a water-based degreasing system.

The workshop was the second of its kind at General Dynamics. The first was held last year at Convair Division.

Pace

(Continued from Page 1)

preted the recent dramatic events in Europe as a "turning point in history" and a reason to "rejoice in the spirit of peace and triumph of liberty." He also cautioned his audience to "pause and think. We've been here before. Today, as in the 1920s and 1930s, we hear voices advocating peace through disarmament. In the 1920s, the United States and Great Britain listened to those voices. Both countries started to sink their navies as a contribution to world peace. All it got us was war."

Because today's world remains a "volatile place" with a great potential for conflict and unrest, Pace urged that "we must never slacken our commitment to a strong national defense." In light of the reduced tensions between the United States and the Soviet Union, Pace recommended that a "rational, gradual reduction and restructuring of our forces and their equipment are in order."

Pace also recommended that Congress, the Department of Defense and industry must join in addressing real and perceived problems in the defense procurement process.

"All three of us created the problem, and all three of us must provide the solution," Pace said. "All three of us must work together to simplify and clarify the procurement process." Pace added that he was "happy to see more and more signs that we are taking the first steps along the road of restoring the public's respect and trust."

He cited Forrestal, the first Secretary of Defense, on the importance of public support for national defense. Forrestal wrote: "The great danger in any country is for people to believe that there is anything absolute about security. Air power, atomic bombs, wealth — by itself, none of these can give any security."

Pace said: "How right he was. It is vital that we, the industry, the Department of Defense and the Congress do whatever is necessary to meet the expectations of the public. We exist only at their will and at their pleasure."

Navy League picks Pace for top honor

Chairman and Chief Executive Officer Stanley C. Pace was to receive his second major award in as many months at the Navy League's Sea-Air-Space Exposition banquet in Washington April 11.

The Navy League selected Pace, who received the Forrestal Award in March, the winner of its 10th annual Nimitz Award. "Your exceptional contributions to U.S. maritime strength and our national security make you a most qualified and worthy choice for this award," Navy League National President Calvin H. Cobb Jr. wrote to Pace. The award is named for Fleet Admiral Chester Nimitz, who led the Navy's Pacific forces to victory in World War II.



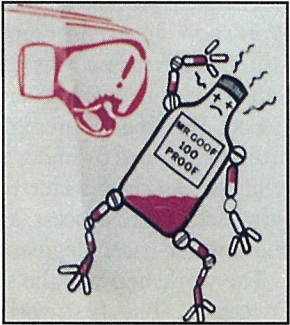
TOM RULE

Quality briefing. Wayland Hicks of Xerox Corp. briefs General Dynamics' Total Quality Management Executive Board, including (from left) Vice President-Communications Bob Morris, President and Chief Operating Officer Herb Rogers, Vice Chairman Bill Anders and Staff Vice President-Total Quality Management Joe Frankovsky. Hicks, executive vice president-marketing and customer operations, told the board about Xerox's total quality management efforts that resulted in winning the 1989 Malcolm Baldrige National Quality Award. His presentation was part of a recent key meeting to fully inform board members about total quality management and how they could lead quality thrusts throughout the company. The session was held over three days, including part of a weekend, off-site in St. Louis. The executive board supports total quality management by providing guidelines, goals and benchmarks and by promoting the transfer of best practices of total quality management throughout General Dynamics. Other members of the board are Executive Vice Presidents Ralph Hawes, missiles and electronics, and Jim Mellor, marine, land systems and international; and Vice Presidents Moon Mullins, government relations; Ed Ewing, operations; Reg Low, technology development and engineering; Blaine Scheidman, contracts, pricing and international offset; Arch Rambeau, human resources; Dave Wheaton, program development and planning; and Jim Cunnane, chief financial officer.

Machinist invents drug war weapon

EDWARD J. TARNACKI was trying to figure out how to help children win the war against drugs when he hit upon an unusual idea.

Mr. Goof.
Mr. Goof is a cartoon character similar to Mr. Yuk, a character used to warn children about poisonous materials. Mr. Goof's torso is a nearly empty liquor bottle. His arms and legs are strings of pills.



Tarnacki, a machinist at Land Systems Division's Scranton, Pa., Plant, devised the character because he believes that visual images are easier to remember than words.

"Mr. Goof is a character that children can identify with like Mr. Yuk," Tarnacki said. "Mr. Goof makes them aware that if they use drugs and alcohol, they can also get sick and become Mr. Goof and a menace to society."

Tarnacki said he has spent more than \$3,000 of his own money printing and distributing Mr. Goof stickers to schools, municipal buildings and police departments throughout the Scranton area.

He has received letters of support from former first lady Nancy Reagan; William Bennett, the director of the office of National Drug Control Policy; and representatives of the Pennsylvania Department of Education. He is trying to convince state officials to put the character on bookmarks and make them available to elementary school children.

Non-profit groups and school districts interested in obtaining free license to Mr. Goof may contact Tarnacki at 408 Hudson Street, Jermyn, PA, 18433.

"All I want is the satisfaction of knowing that I may have done something to prevent children from using drugs," Tarnacki said.

■ Jack Price

Schools get message on substance abuse

ABOUT 22,000 CHILDREN in the Detroit area are receiving messages on the perils of substance abuse, thanks to a program initiated by Land Systems Division employees at the Detroit Arsenal Tank Plant.

The tank plant supplies posters on substance abuse to nearby schools each month. The brainchild of Robert A. Paulisin, tank plant chief administrator, the program started in 1988 when posters were sent to one high school. The program soon expanded to elementary and junior high schools in the district and then spread to other districts.

"We wanted to bring about awareness of something that's important to everybody — substance abuse," Paulisin said. "And where better to start than with our country's most valuable resource."

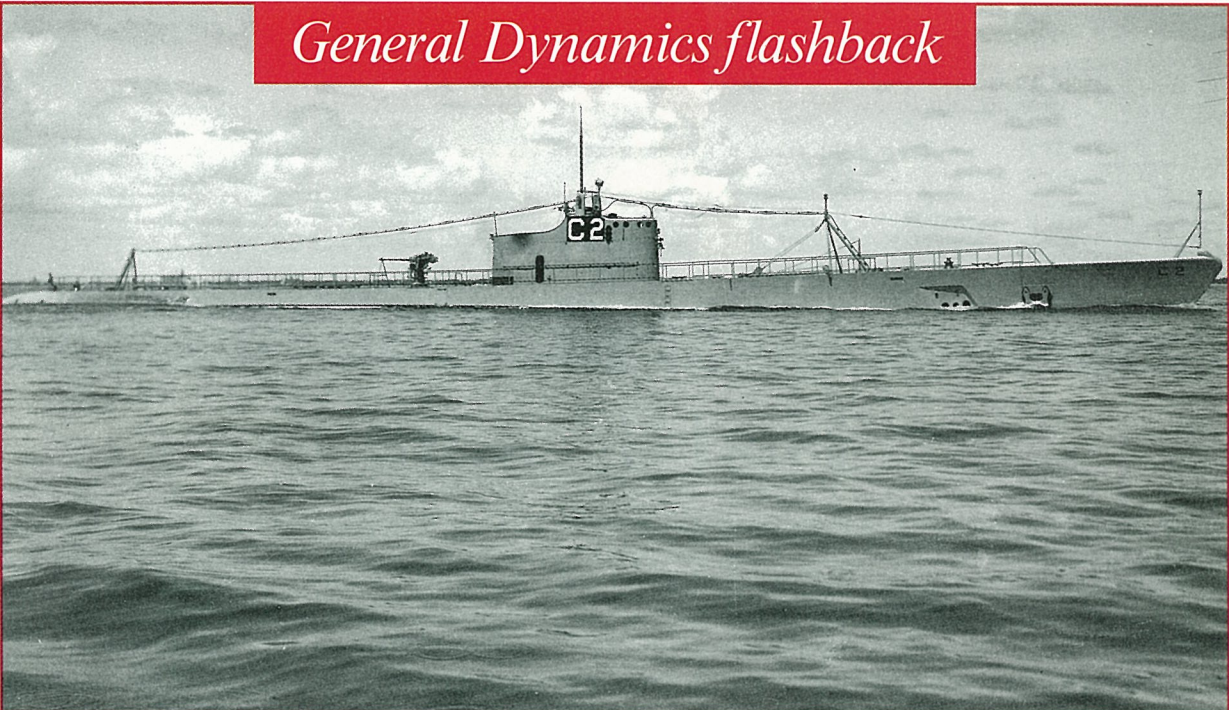
The Roseville School District most recently received posters from the tank plant. Charles M. Hall, tank plant manager, discussed the program with 50 of the district's 6,700 students at a kickoff meeting.

■ Jack Price

Savings and Stock Investment Plans

	Annual Rate of Return for the 12 Month Period Ending:		
	Feb. 1988	Feb. 1989	Feb. 1990
Salaried			
Government Bonds	6.9%	6.2%	8.8%
Diversified Portfolio	(4.3)%	13.2%	18.9%
Fixed Income	11.2%	10.6%	10.3%
Hourly			
Government Bonds	7.1%	6.3%	9.0%
Diversified Portfolio	(4.4)%	13.3%	19.3%
Fixed Income	11.2%	10.5%	10.3%
GD Stock Closing Price	\$52.50	\$50.75	\$37.25
() Denotes Negative Number			

General Dynamics flashback



Cuttlefish was the first Navy submarine built by Electric Boat at its shipyard in Groton, Conn.

Cuttlefish pioneered sub construction

Often a technological advance is marked by the name of a specific product. In the construction of submarines, this is the case with *Cuttlefish*, the first U.S. submarine built at Electric Boat Division's shipyard in Groton, Conn.

Before *Cuttlefish* was launched in 1933, all submarines were completely riveted. After *Cuttlefish*, all submarines were completely welded.

Cuttlefish was a composite of the two. It was partially riveted, but, in a bold experiment by Electric Boat, it also was partially welded. The new construction technique proved so successful that *Cuttlefish* became the prototype for the completely welded "fleet-type" submarines that became dreaded weapons during World War II.

Cuttlefish was the second of a new class of submarines ordered by the U.S. Navy based on World War I combat experiences and German U-boat designs. The new *Cuttlefish* design was surface oriented, with a knifelike hull that could cut quickly and smoothly through the water without bouncing on the waves. The bridge was much drier. The wooden deck was surrounded by a permanent life rail.

Submarine commanders had found that torpedoes were unsuited for fighting small ships, and the installation of a deck gun and a life rail allowed the submarine to become a surface fighting ship and attack small craft and planes. However, it slowed the submarine's underwater speed to only about 17 knots.

Large free-flooding holes allowed for rapid submerging. But with a length of 274 feet and an operating depth of only about 250 feet — and a collapse depth well above 400 feet — rapid dives were a necessary challenge to the abilities of the captain and crew during depth-charge attacks.

Depth-charged at least three times and bombed at

least once, *Cuttlefish* survived three war patrols, sank at least one Japanese tanker, threatened or damaged many others, won two battle stars and ended its days as a U.S. Navy training ship.

Before World War II, the boat was assigned to the Submarine School in New London, Conn. *Cuttlefish* conducted diving operations, experimental torpedo firings and other exercises in various parts of the world. It was ordered to Pearl Harbor in 1939.

After an uneventful first war patrol in early 1942, *Cuttlefish* was assigned to cruise near Saipan and the northern islands of the Marianas group. There, on May 19, 1942, it attacked a patrol ship and endured hours of severe depth-charging. *Cuttlefish* was depth-charged again five days later when it challenged three enemy destroyers. The next day an enemy plane caught it on the surface and dropped two bombs as the boat submerged. Both missed.

When it was discovered that the Japanese fleet was out in strength, *Cuttlefish* patrolled about 700 miles west of the Midway islands, remaining there during the Battle of Midway June 4-6.

Cuttlefish began its third and last war patrol in late July 1942. On Aug. 18, patrolling off the Japanese coast, it attacked a destroyer and received a punishing depth-charge attack in return. Three days later it launched a salvo of torpedoes and hit a freighter with three of them and an escort ship with one. Explosions indicated the hits, but no sinking ships were confirmed. On Sept. 5, *Cuttlefish* attacked and was believed to have sunk a tanker.

Overage for continued strenuous war patrols, *Cuttlefish* was ordered back to New London in September 1942, where it served the Submarine School as a training ship until 1945. It was decommissioned at Philadelphia later that year and was sold as scrap in 1947.



School with class. Turkish third-grade students study at the Falcon School in Murter, Turkey. More than 260 children are enrolled at the school, which opened last year for children of employees at the nearby TUSAS AEROSPACE INDUSTRIES factory. The plant builds F-16 Fighting Falcons. Children of Americans working at the facility attend an American school in Ankara.

NURSEL KORAN

TQM

CASE STUDIES

Work crew takes over, trims time, lifts quality

IT'S SIX O'CLOCK in the morning and Convair Division's MD-11 fuselage first shift has just clocked in. The daily "stand-up" meeting is under way for the crew of Item 580, a complex panel assembly containing the cargo door that sits just forward of the wing of the McDonnell Douglas jetliner.

Last June the crew took 1,825 hours to build Item 580 with 15 quality assurance reports, 462 defects and 360 hours of rework and repair. Five ship sets later, the time to build had dropped to 995 hours with zero reports, defects and rework and repair.

What happened in between? At the start of ship set 458 the 10-member Item 580 crew took ownership of their processes by planning their assembly sequence, team member assignments, time to build the item, and cross-training needs.

Chuck Hannabarger, MD-11 total quality management coordinator, Jay Rief, industrial engineer, and operations supervisors Bob Perkins and Dan Brooks served as facilitators for the pilot project. The facilitators provided initial training and brought in the right people from tooling, inspection and other functions needed to solve problems identified by the crew.

It was important to the success of the project to use it in an area where management, supervision and the assemblers were receptive to the philosophy of total quality management, Hannabarger said. Total quality management depends on teamwork, continuous process improvements and no barriers between management and employees.

Item 580 is still consistently one of the best performing items on the MD-11 line even though some members of the original team have been promoted or reassigned. The crew members continue to monitor their performance by tracking progress, cost and quality at their daily meetings.

Hannabarger and Rief are hopeful that other employee empowerment projects can be initiated throughout the MD-11 fuselage assembly line. A huge tooling and manpower buildup is under way to support pro-



The Item 580 team (clockwise, from left): Domingo Jutajero, Mario Ruvalcaba, Alex Arellano, Sergio Espinosa, Frank Noles, Al Gentry and Tuyen Dao.

duction, which will more than double in 1990 and peak at 50 fuselages per year by 1992.

To the customer, quality of the fuselage is paramount, and though quality is good the cost has been high because of rework. The Item 580 project proves that cost can be driven down through employee ownership, Hannabarger and Rief said. Costs can also be cut through other special action teams looking at overall tooling, parts and training issues that affect a

specific assembly team like Item 580, they said. "My goal is that everyone should think that's 'my' airplane we're building out there," Hannabarger said.

The original members of the Item 580 crew: Mario Ruvalcaba, Alex Arellano, Sergio Espinosa, Frank Noles, Al Gentry, Tuyen Dao, Domingo Jutajero, Norman Doran, Dan Portillo, Bob Perkins and Dan Brooks.

■ Julie Andrews

Electric Boat finds methods to manage boat-building changes

CHANGE IN SUBMARINE construction is routine at Electric Boat Division. The government may request an upgrade or the shipyard in Groton, Conn., may reconfigure its manufacturing plan. But whatever the change, sustaining a smooth transition and uninterrupted flow becomes a major challenge when a single boat requires as long as six years to build.

That is why change management became one of nine critical total quality management items identified at the end of last year by a staff-level steering committee. The processes were selected because they are essential to the division's survival, are linked to Electric Boat's operating and strategic plans, consume excessive resources, significantly impact product delivery and service, and can meet new market demands and improve customer satisfaction.

The change management initiative was aligned with the division's operations organization because the activity ends up at a boat under construction.

"Changes have been nominally viewed as a contracts and estimating process, but implementing the changes is accomplished by the operations group," said Dale R. Banks, director of estimating and head of one of the change management action teams. "We need to make sure that the estimating organization is satisfying the needs of the operations people. In the world of change management, operations is our customer. And we want changes to be as least disruptive as possible to the trade functions."

Three special emphasis teams were established to analyze the detailed evolution of the change process. They searched for redundancies and improved turnaround time.

One team has been tasked with identifying changes. Another team is responsible for configuration management, which involves the changes' status. The third team has been examining the effect of changes upon



Discussing the flowchart for new construction contract changes are (from left) Dale R. Banks, Robert P. Sedotti, Tammy L. Young, Todd K. Rich, William H. Boots and Steven S. Middel.

construction schedules and original contract price.

"We created a step-by-step flowchart for a new construction contract change, which measures on paper nearly 38 feet long," said Technical Support Chief Robert P. Sedotti, leader of the third team. "This way we were able to analyze who performs each step, what activity is involved in each step, and what computer systems support the flow. We have it color-coded to represent the different functional areas within the department, as well as the outside groups in engineering, planning and materials that are integrally involved in the process."

The team recommended ways to make the process faster and more efficient. "The flowchart focuses on the time from when a change is identified to when our package to accomplish it is settled judicially with the

government," Sedotti said. "We want to reduce the flow to the minimum possible time. After all, we receive changes all the time and most of them represent additional revenue. What this circuit does is determine when entitlement is due so we can receive the additional dollars as a result of the change."

A unique aspect of the initial change management action team, according to Banks, is that a Navy representative from the Supervisor of Shipbuilding's office is a member.

The change evaluation team recently presented its recommendations before a review board from operations. "Once we've received approval, we'll be able to create a revised flowchart," Banks said. "And once we have an improved flow, we'll see opportunities to revise even further."

■ Graham Gavert



Firefighters practice extinguishing a blaze in a vacated barn donated for the exercise by Material Service Corp.

Material Service fires up authorities

IT'S BEEN A FEW YEARS since Mrs. O'Leary's cow started a fire in her barn. This time another party was to blame for igniting a fire in a Chicago barn — but for a good cause.

About 20 firefighters from three Chicago North-West Suburban fire departments recently took a match to two Material Service Corp.-owned structures. The buildings were an old frame house and a large wooden barn vacated last year.

The structures needed to be demolished to mine reserves located under the buildings. Mining the reserves is part of an expansion program by Material Service's East Dundee sand and gravel operations. Material Service offered local fire departments the opportunity to set the buildings alight and practice firefighting techniques.

The practice is valuable to the local departments. Very few of those participating in the exercise had ever extinguished a fire, according to East Dundee Fire Lt. Steve Hardy.

The participants set fires in various rooms of the home to apply different firefighting techniques. One team extinguished the fires while another searched for folded fire hoses that served as "victims." Six state-certified instructors supervised the exercise.

■ Peter Stamos

Meredith's economic crystal ball sees all

THE ACCURACY OF Eddie Meredith's economic predictions are becoming a tradition at Electric Boat Division.

Meredith, a purchasing specialist at Electric Boat, usually finishes among the leaders in a yearly magazine contest to predict seven national economic indicators. But he outdid himself in 1989.

Purchasing World, the sponsoring magazine, recently announced that Meredith won its 1989 Crystal Ball contest.

"When they called to tell me I'd won, I couldn't speak," Meredith said. "Normally I don't react too much to things, but from the way I looked, people thought I'd won the lotto."

He did win a personal copier for finishing first.

Meredith is no stranger to honors in the contest. He finished fourth in 1988. He has been among the top 100 since the magazine began publishing those results in 1985. He has entered nine Crystal Ball contests.

Contestants are asked to predict results of seven economic indicators: the consumer price index, capital spending, factory operating rates, real growth of the gross national product, gross national product implicit price deflator, industrial producer price index and industrial production index. The entries are due in August. They are judged against the figures released by the U.S. government the following February.

The contestant with the lowest deviation from actual results is the winner.

Although his victory was unexpected, Meredith had been confident that his score was good. "Part of my job is to make forecasts, so my predictions weren't just guesses," he said. "I work out the assumptions based on what I've been reading about the tenor of the economy. You have to reason out your answers, while using intuition as to the possible changes up ahead."

■ Graham Gavert

Employee contribution programs netted more than \$6 million in '89

This is the last in a three-part series on General Dynamics contributions programs.

When Fort Worth Division General Manager Charles Anderson was named to spearhead the United Way Campaign for Metropolitan Tarrant County, employee members of the division's Con-Trib Club decided to rally around his efforts.

"Normally, the majority of our funding is directed toward United Way agencies," said Bill Neal, manager-human resources, whose department administers the Fort Worth Division Employees' Con-Trib Club. "This year, we made a pledge of \$3.75 million, the largest pledge ever made to United Way of Metropolitan Tarrant County. We're very proud of that accomplishment."

The gesture by the 31,000-member Fort Worth employee organization is symbolic of General Dynamics' employee contribution programs such as the Fair Share Club at Valley Systems, the Community Services Association at Electric Boat or the Con-Trib clubs at the San Diego divisions.

The various General Dynamics' employee contributions programs collected more than \$6 million in 1989. Combined with the almost \$3 million the Corporate Office contributed nationwide and the more than \$2.3 million bestowed by the company's divisions and subsidiaries, the company dedicated approximately \$12 million to charitable institutions. Those figures do not include donations from those individuals at divisions that do not have organized employee groups.

"We're very fortunate that we're dealing with people who believe in volunteer giving... who believe in meeting human needs," said Neal, whose Con-Trib Club also includes Data Systems-Central Center.

The Convair/Space Systems/Data Systems-Western Center Con-Trib Club is unique because its funds are directed toward specific community needs that their local United Way often doesn't meet, according to Steve Woolley, manager-employee benefits and chairman of the club. The club, which represents the 14,400 employees at Convair, Space Systems and Data Systems-Western Center, had a budget of over \$1 million in 1989. Their budget of \$1.2 million for 1990 includes a pledge to the local United Way of \$1 million.

The bylaws of the San Diego unit, which originated in 1952, is indicative of the rest of the employee programs: "to recognize charitable, health and human care institutions and organizations... through a single channel via payroll deductions." The funds are

administered by a volunteer board of employees.

"We are very active," Woolley said. "We generate a lot of dollars and spend a lot of dollars. We hold a campaign every year and based on the results of that campaign, we prepare a budget. Last year we gave to over 50 agencies in addition to United Way."

Such programs usually encourage employees to donate a percentage of their salaries. At Fort Worth, for instance, employees are encouraged to give from one to two hours' pay per month, depending on income. The contributions are taken through payroll deduction.

"We invited all new hires, during orientation, to join our effort," Neal said. "And then we have a campaign once a year. Employees may restrict their donations to United Way, an emergency assistance program or an approved Con-Trib Club line agency."

Electric Boat's Community Services Association uses incentives to generate donations. Last year a drawing for a trip to Hawaii or the cash equivalent was the inducement for any participant contributing \$1 or more per pay period.

"More than 70 percent of the EB employees participate in the program," said John Latham, manager-human resources administration. "That's an approximate 10 percent increase over last year."

That includes contributing to agencies ranging from the YWCA day-care for employees' children to homeless shelters, food and emergency assistance programs and the Cystic Fibrosis Foundation. The Community Services Association has a 12-member board composed of eight union employees and four management personnel.

At Electronics Division's Con-Trib Club, which has an 80 percent participation rate, approximately 5 percent of the funds are held out for discretionary use, according to Bob Farrar, human resources administrator.

"We allocate up to 10 percent of the funds for employee emergencies and the rest goes to local charities," he said. "That includes about 80-85 percent that goes to United Way."

Farrar noted the discretionary fund is basically the money with which Electronics can be somewhat "creative." For instance, last year the division answered a need from the University of California-San Diego hospital, which requested funds for needed lounge chairs for its AIDS ward.

"We're all just looking to put money back into the communities where our people reside," Latham said.

■ Myron Holtzman

Employee contributions clubs*

Division	Name	'89 Budget
Fort Worth, Data Systems-Central Center	Con-Trib Club	\$3,579,000
Convair, Space Systems, Data Systems-Western Center	Con-Trib Club	914,000
Electric Boat	Community Service Assn.	948,200
Electronics	Con-Trib Club	159,273
Pomona	Con-Trib Club	340,000
Valley Systems	Fair Share Club	150,000
Total		\$6,090,473

* Includes only divisions with employee groups.

Matching gift questions? Check before donating

Anyone contemplating a contribution that would qualify for a matching company donation should keep in mind the changes made to the matching gifts program in 1989.

Those who are uncertain if their donation qualifies for a matching gift should call Barb Stuart, Corporate Office matching gifts administrator, before contributing. She can be reached at (314) 889-8279.

Types of organizations eligible for matching gifts were expanded in 1989 to include public television and radio, historical societies and preservation and conservation groups. Secondary schools, hospitals and walkathons and similar charity events are no longer eligible.

The minimum donation that can be matched is \$50. Gifts of stock will not be matched.

Employees with at least six months of service and retirees with a minimum 10 years' service are eligible to participate.

Matching gift forms are available from local administrators.

Pomona puts on the pressure with autoclave

IT LOOKS LIKE A GIANT pressure cooker or a boiler from a steam locomotive.

But Pomona Division's new autoclave represents a state-of-the-art advancement in making laminated material. The material ends up as part of the division's electronics circuit card and flexible harness assemblies.

The autoclave has improved quality while tripling the number of boards that can be produced, according to Bob Jones, a production engineer on the electronics fabrication team.

The autoclave applies uniform pressure assisted by vacuum in a sealed chamber. This process laminates multilayer printed wiring boards, printed flex cables and bonded strip line boards. These parts connect the electronic circuits for the division's Standard Missile, Phalanx close-in anti-air gun and Sparrow air-to-air missile.

A microprocessor controls the time, temperature and pressure. Inside the chamber, more than 500 pounds per square inch of pressure is created at 400 degrees temperature. The chamber is unsealed five hours later and the finished sheet of laminate, nearly 1/8-inch thick, is ready for further processing.

"For more than 35 years we have been laminating parts together the same way as everyone else in the industry does — with hydraulic presses applying heat and pressure," Jones explained. "But we could only load and press 12 panels at a time."

Jones said Pomona's eight hydraulic presses combined could turn out only 64 finished panels per shift, and uniform pressure couldn't be guaranteed. There was also a greater chance the sections would move as the pressure was applied. Pressure also tends to distort the plates that hold the raw materials in the press, causing frequent replacement of the plates.

Using the new process, the set of raw materials is sandwiched between the tooling plates and placed in a heavy plastic bag. The bag is connected to a suction hose to remove the air between layers, preventing movement and assuring a clean product. Up to 10 bags can be placed on racks and sealed in the chamber.

The process results in less handling by employees, less wasted material, a fivefold increase in productivity and a significant gain in quality.

"The new process takes about two hours longer than the old presses," Jones said. "But because we can load and laminate more boards at once, we can average 250 panels in one load versus our previous 12."

Board types and sizes can also be mixed in the same load. The hydraulic press can only handle one size and type of board.

The lamination team is excited about the new system,



Charles Ortega, a lead person on Pomona's electronics fabrication production team, loads the autoclave to make laminated printed circuits. The autoclave has improved quality while increasing the number of printed circuits that can be laminated at any one time.

Jones said. "We had to do some redesign of our work flow since the new process came on line about nine months ago," he said. "But the section employees have really taken ownership and are making suggestions to improve the process."

Electronics Fabrication Director Mike Olivieri agrees. "This is just a typical example of breakthrough thinking and team dedication to process improvement and increased productivity," he said, adding that the

new process has yielded improvements "beyond expectation."

Pomona is actively pursuing work from its sister divisions as well as outside sources who desire to take advantage of the high quality and competitive cost offered from the new technology. The division is working to acquire a second autoclave from the manufacturer, Advanced Controls Corp., to add capacity for extra work.

■ Eric Solander

Keynote speakers set for software meeting

KEYNOTE SPEAKERS Art Hirsch, president and chief executive officer of the Software Productivity Consortium, and Chris Anderson, program manager of the Ada 9-X project, will highlight the Corporate Software Technology Conference.

The fifth annual event will be held at the Doubletree Hotel in San Diego May 16-18. The conference is open to all General Dynamics employees. The agenda will include presentations of papers and other activities dealing with software technology.

Anyone interested in attending should contact Diane Blankenburg at Data Systems Division-Western Center. Her Data Systems address is Mail Zone 16-5530, P.O.-Box 85808, San Diego, CA 92138. Her telephone number is (619) 547-4555. She may be contacted on EM/OS by addressing messages to SABUDA,JD.

One-color badges boost unity

VALLEY SYSTEMS DIVISION has broken with the tradition of requiring separately colored badges for salaried and hourly employees. All Valley Systems workers are switching to badges with a gold logo.

"Using separate colored badges tends to imply that the work force consists of not one team but two separate teams with different goals," said Pete Wylie, division vice president-human resources and administrative services.



Electric Boat briefing. Vice Chairman Bill Anders (left) hears how a computer numerical control boring mill cuts out the inside diameter of a torpedo tube test piece during a recent visit to Electric Boat Division. Briefing Anders is First-Class Inside Machinist Sal Vlaun. Anders also toured the Groton, Conn., shipyard and met with division management.

Hugo-hit Charleston Facility in full swing

The November issue of General Dynamics World reported on relief efforts for Electric Boat Division's Charleston, S.C., Facility and its employees after Hurricane Hugo heavily damaged the area Sept. 22. A follow-up story appears below.

ANYONE FAMILIAR WITH Electric Boat's Charleston Facility who hasn't seen it since before Hurricane Hugo will notice something.

The place looks better than it did before the hurricane.

"Some of the people we talk to on the telephone from other parts of the country are still asking when we think we'll recover," said Jay Crowley, human resources manager at Charleston. "Well, we've been 'recovered' for a long time."

Damages exceeded \$5 million. But structures have been repaired or replaced and the facility never fell behind schedule making submarine hull sections for assembly at other Electric Boat locations. Production resumed just three days after the hurricane. That was no simple feat. Five weeks later, 15 percent of area businesses still had not restarted even limited operations, according to the Charleston Chamber of Commerce.

"It surprised me that we were back so fast," said David Kennedy, lead person in material control.

Time was important. "We are a critical part in the flow of submarine construction," Charleston General Manager Dick Gregory said. "If we're late, the whole evolution backs up. We didn't have separate options of either rebuilding or keeping up production. We had to do both."

The facility's employees and other Electric Boat locations share credit for Charleston's comeback.

Every worker suffered some degree of personal property damage from Hugo. Still, employees logged 15-20-hour days in the week after the hurricane so production could resume. Team members' pressing personal needs, such as removal of trees that had fallen on their homes or patching of roofs, were met by a crew of 20 fellow employees organized by Foreman John Benner.

Meanwhile, Electric Boat headquarters in Groton,



General Manager Dick Gregory (above) and the 500 other employees of the Charleston Facility have completed repairs while keeping production on schedule in the aftermath of Hurricane Hugo. The hurricane heavily damaged the Electric Boat Division location, including the 225-foot-high Final Assembly Building in the background of the photo.

Conn., Electro Dynamic in Avenel, N.J., and Quonset Point in North Kingstown, R.I., provided critical equipment and support personnel. "We couldn't have gotten back on line without the rest of the division," Gregory said. "For example, large generators and technicians to run them were here two days after the hurricane."

Employees throughout Electric Boat helped lighten personal damage too. They donated six truckloads of food, clothing and other goods, and gave more than \$5,000 to an emergency relief fund. The money eventually went to five workers who lost everything.

Were it not for the scores of splintered trees outside company property, no evidence of the hurricane remains at the Charleston Facility. There are new classroom and medical facilities and the administration building has a new interior. The 225-foot-high Final Assembly Building has had its punctured roof closed. A 175-foot-high door that was torn off has been replaced. The facility is using the opportunity to install a new communications network that has improved tele-

phone service and will eventually link to computer-aided design/computer-aided manufacturing terminals at other Electric Boat locations.

"We've come a long way," Gregory said. "We're better than we were before Hugo."

Better than just a cosmetic face-lift: Many employees say the hurricane has made them a tighter group. "It was pretty good the way people worked together," said Tom Jelinek, an administrator. "There were no hourly or salaried employees. Whoever got to the broom first pushed it."

Reconstruction required many hours of hard labor, first in mud that sucked boots off feet and later in steamy sunshine. Jelinek, who supervised cleanup of the site's 98 acres, sent workers as far as two miles away to pick up sheet metal that had blown off company buildings. He had 35 people sewing as many as 50 20-foot-by-40-foot nets a day for hanging inside the Final Assembly Building. The nets had to go up to catch falling material during roof repairs before workers could safely resume production on the floor.

The company helped the community as well. The Charleston Facility sent employees to assist various relief efforts while paying their wages. "We had 50 people out there for two weeks," Benner said. "We established some excellent connections with the community."

Added Jack Vertefeuille, an educational instructor: "I'm very proud to be a member of GD. GD did more for the community than the majority of companies around here."

The Charleston Facility is also looking to do more for itself. "We are very competitive in steel fabrication and the facility is nowhere near capacity," Gregory said. "We're looking at the feasibility of expanding into other work areas."

Expansion may have been the last thing on many employees' minds when they first saw their battered workplace last September and wondered if they still had jobs. They do, and the Charleston Facility has hardly missed a beat. ■ Dave Lange

Kids carry on Phillipp's fervor for space exploration

EACH YEAR, 10 CHILDREN will follow in Bill Phillipp's footsteps.

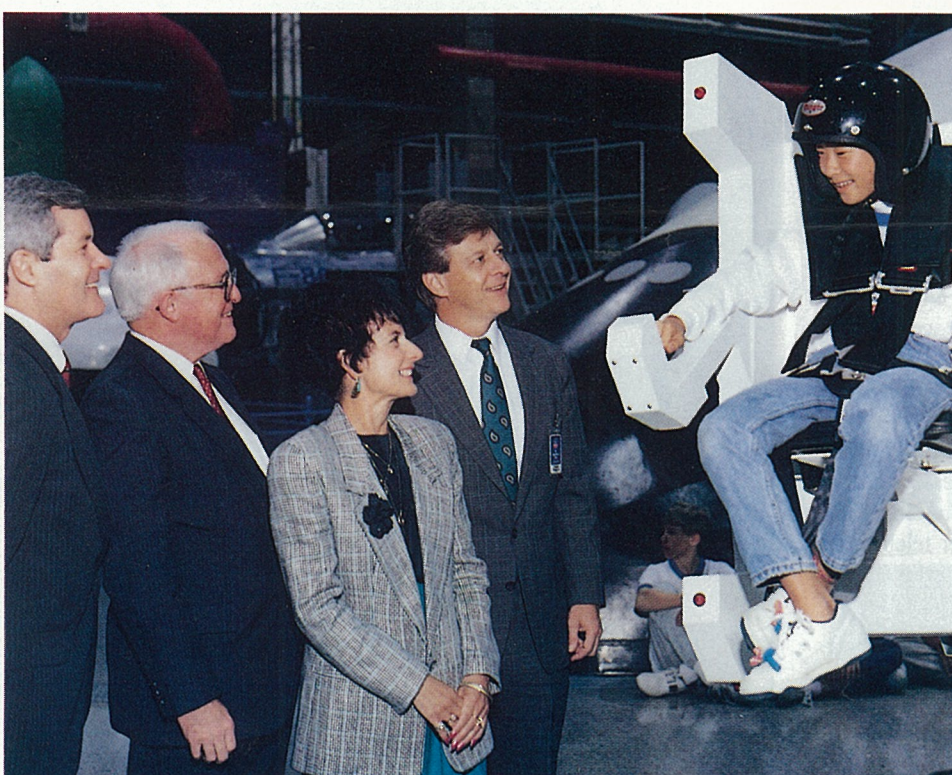
Phillipp, who died last year at age 57, spent a 33-year career with General Dynamics and the space program. He helped test new space technology and launch satellites that explore the solar system.

Space Systems Division has instituted a \$10,000 annual scholarship program at the U.S. Space Camp in Huntsville, Ala., to honor his memory. The William G. Phillipp Memorial Scholarship program will send 10 employees' children or disadvantaged San Diego youths to the camp each year.

Phillipp's widow, Jan, and Space Systems General Manager Alan Lovelace recently presented a \$20,000 ceremonial check to officials in Huntsville for two years' funding.

"I think that if Bill were here, he would say that his career successes were all due to a team effort, just like what you are teaching these students at Space Camp," his widow said at the ceremony. "I am thrilled that these scholarships in Bill's name will give young people the opportunity to attend Space Camp who otherwise might not be able to do so. Bill would agree."

The check was accepted by Edward O. Buckbee, director of The Space and Rocket Center and founder of Space Camp, and George M. Beason, chairman of The Alabama Space Science Exhibit Commission. Also



Space Camper Kristen Brilhante demonstrates manned maneuvering unit to (from left) Edward Buckbee, Alan Lovelace, Jan Phillipp and George Beason.

attending were George Philyaw, manager of the Huntsville engineering office; Alda Jorgenson, Space Systems community relations; and Tom Phillipp, Bill's brother who is manager-quality assurance systems effectiveness.

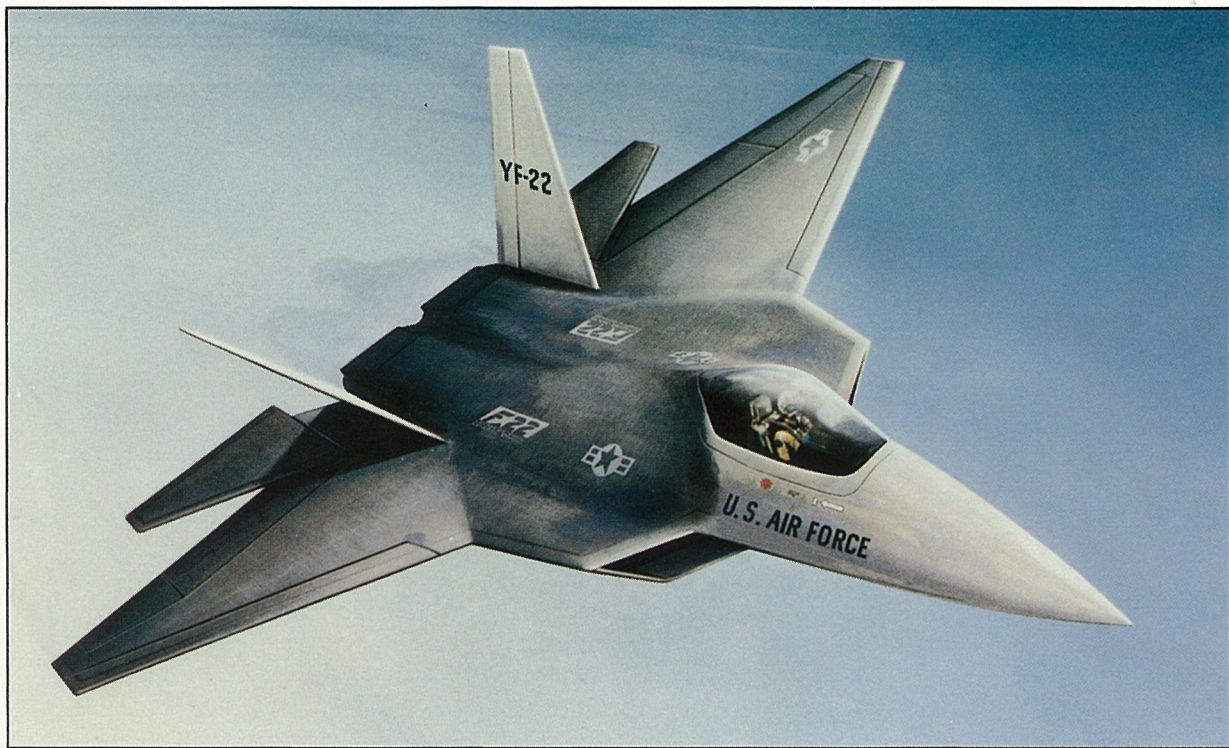
"Today we honor the memory of a man who exemplifies all the fine people who have kept America a leader

in space over the last 30 years," Lovelace said. "It is our intention that this scholarship program will help find the future leaders who will lead our exploration into space. If we inspire even one student to study engineering or to become an astronaut, we will be generously rewarded for our investment."

Space Campers range from elementary to high school ages. Camp consists of a weeklong program of hands-on activity in astronaut training and participation in realistic space shuttle simulation missions. Trainees also study the history of rocketry and build and launch solid-fueled rockets.

The year before he died, Phillipp had led General Dynamics' effort to win the Air Force Medium Launch Vehicle II program, awarded to Space Systems in 1988. Phillipp spent many years at Cape Canaveral, Fla., where he was test conductor—the man who pushed the button—for many flights that made space history sending spacecraft to the moon, the sun, the planets and beyond.

Space Systems maintains an engineering office in Huntsville that is expected to grow steadily over the next few years to support the activities of Marshall Space Flight Center programs. Those programs include future space transportation systems such as Shuttle C and liquid rocket boosters for heavy-lift launch vehicles. ■ Julie Andrews



Latest look at ATF. The Department of Defense recently released this artist's concept of the YF-22, the aircraft being offered by team leader Lockheed and teammates General Dynamics and Boeing as a candidate for the Advanced Tactical Fighter. The other entry for the Air Force's next-generation fighter is the YF-23 from the team of Northrop and McDonnell Douglas.

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Salaried employees to benefit from pension plan improvements

IMPROVEMENTS have been made to the General Dynamics Salaried Retirement Plan. The changes will be effective July 1.

Some of the plan's features:

- A new benefit formula will base benefits upon average salaries earned in the years before retirement, instead of career average annual salaries under the current formula. This will include 100 percent of Incentive Compensation Plan bonuses.
- New early retirement features include unreduced early retirement benefits at age 62 and a modified early retirement pay schedule.
- The minimum monthly retirement benefit will rise to \$26 per year of service from \$22.
- Benefits will increase 8 percent for salaried employees who retired before Jan. 1, 1985.

Salaried employees will receive more information about the retirement plan later this month. In addition, all plan members 53 or older will receive a personalized statement displaying the effects of the changes on them.

All other salaried employees will receive this information in their 1991 personal benefit statement distributed next March.

The plan's new final pay formula will provide better pension benefits in the long term for most salaried employees because salaries are typically higher later in a career than earlier. The final average pay figured into the formula will equal the average of the highest consecutive 60 months' compensation received during the last 120 months of salaried employment. This is usually the last five years of employment.

Cases will exist where an employee's benefit would be larger under the old career average formula. So that no "takeaways" will occur, all salaried plan members as of June 30 will be grandfathered under the career average formula in addition to being covered by the new final pay formula. Grandfathered members will receive the higher of the two benefits as calculated at retirement.

The new Salaried Retirement Plan must be reviewed by the Internal Revenue Service, but no problems are anticipated for obtaining approval.

Time to focus on Photo Contest II

General Dynamics' employee photo contest.

You've had a year to think about it. You could kick your tripod for not adding your photograph to the 715 entries in 1989's inaugural event. You'd bet your Pentax that you could have submitted a photo every bit as good as the winners.

Get ready to manipulate your Minolta, click your Kodak and fire your Canon. Here's your chance to make amends. Entries are now being accepted for Photo Contest II. All full-time and permanent part-time General Dynamics employees, except company photographers, are eligible.

Any 8x10 color or black-and-white photo taken since June 1, 1989, can be entered. Photos must be received by Friday, Sept. 14. Each employee may

submit only one entry.

What's in it for you? A double exposure: publicity and a prize. Twelve photos chosen as winners and 36 selected as runners-up will be printed in a 1991 calendar. A calendar inserted in this issue of *General Dynamics World* displays two winners and six runners-up from last year's contest. Each of Photo Contest II's 12 winners will also receive a \$200 U.S. Savings Bond. A \$100 bond will go to each of the 36 runners-up. A panel of General Dynamics photographers and communications experts will pick the winners.

Other contest rules:

- Each entrant's full name, division, home

(Continued on page 3)

News Briefs

Cessna offering two new business jets to replace Citation IV

Cessna Aircraft Co. is expanding its Citation business jet line with two aircraft, the Citation VI and the Citation VII. They replace the Citation IV announced last October.

Both new models are variations of the Citation III, Cessna's top-of-the-line business jet. The Citation VI will include Citation III cabin size and performance at a lower cost; deliveries will begin next April at \$6.825 million apiece, more than \$1.4 million lower than a typically equipped Citation III. The Citation VII is a higher-powered version of the Citation III and will cost about \$8.6 million. Delivery will start in January 1992.

"The message that we heard, loud and clear, was that the increased size we had planned for the Citation IV was not a high priority," said Roy H. Norris, senior vice president-marketing. "What our customers wanted most was a lower-priced version of the Citation III and a higher-performing version with much greater payload/range and larger engines, but without an increase in cabin size, and at a very competitive price. This led to our decision to discontinue the Citation IV and offer the Citation VI and VII instead."

Secretary of year selected

Maria A. Ballinger has been named Valley Systems Division's secretary of the year. Ballinger, executive secretary to Dave Cumbie, director-manufacturing resource planning, received a plaque and cash.

She was cited by General Manager Mike Keel for demonstrating outstanding performance, excellent secretarial skills and a cooperative attitude.

Army puts Scranton to test

Land Systems Division's Scranton (Pa.) Plant has joined two other division locations in a rigorous government program that recognizes quality contractors.

The Army's Tank-Automotive Command recently enrolled Scranton in the Contractor Performance Certification Program. The facility must meet rigid quality and production standards over the next year to be certified. Certified contractors have less government in-plant quality assurance involvement in day-to-day activities.

Land Systems' Detroit Arsenal Tank Plant successfully completed the program and was certified in January. The division's Sterling Heights (Mich.) manufacturing facility began the certification process in February.

Master's program launched

Electric Boat Division will sponsor the University of New Haven's program for executives to earn master's degrees in business administration.

The division will provide space for classes in Groton, Conn. Fifteen students from 12 companies will participate. The program is tailored to fit schedules of full-time business persons. The 15-year-old program has graduated over 600 students, including 10 from Electric Boat and one from Data Systems Division-Eastern Center.

Company ad... pages 4 and 5

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58-122

UAW, company sign substance abuse pact

General Dynamics and the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) recently signed a comprehensive agreement on alcohol and drug abuse.

"This program is primarily directed to rehabilitate those with alcohol or drug abuse problems; it is not a punitive program," said a joint announcement issued by Stan Marshall, union vice president and director of the General Dynamics Dept., and Jack Fogarty, General Dynamics corporate director of labor relations.

"While the UAW has not changed its basic position on substance abuse, bargaining over this issue was necessitated by the national concerns over alcohol and substance abuse in the workplace and by Department of Defense directives, federal law, Supreme Court decisions and National Labor Relations Board rulings," Marshall said. He explained that "the agreement falls well within the substance abuse policy adopted by the UAW's International Executive Board. Alcohol and drug abuse counseling and treatment, rather than discipline, are the cornerstones of the program."

Added Fogarty, "This agreement was reached following extended negotiations and forms a firm basis for cooperation between General Dynamics and the UAW on an issue important to General Dynamics, the UAW and the country." The agreement, overwhelmingly ratified May 6, covers more than 6,000 General Dynamics employees represented by the union at Land Systems Division facilities in the Detroit area, Lima, Ohio, and Scranton, Pa., and at Electric Boat Division facilities in Groton, Conn., and Avenel, N.J.

The agreement provides that union and company officials receive training in recognition and identification of employee alcohol and drug abuse, alcohol and drug testing procedures and safeguards, and methods of referring employees to General Dynamics' employee assistance program.

The agreement includes "for cause testing" based on objective evidence of on-the-job impairment. Random testing may be performed only on employees in safety or security sensitive positions.

A joint oversight committee has been established to review testing procedures, collection methods, quality assurance, laboratory selection and sanctions that pertain to the operation of the agreement. This committee will consist of members chosen by the union's international vice president and the company's vice president-human resources.



Inside job. Space Systems test engineer Rich Fagan inspects a Centaur upper stage interior.

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Current & Comment

It's a war out there...

Governments grapple with governments. Institutions dispute institutions. Society spars and squabbles with itself. Meanwhile, down in the trenches, individuals sometimes face up to their own personal conflicts with an uncommon courage and rare resolve.

On Aug. 31, 1970 — his 18th birthday — Dalton S. left his hometown of Austin for Houston's Texas Southern University. With an engineering degree in mind and track scholarship in hand, he was on his way. But within two years, marijuana and liquor had pushed academics and athletics out of the picture and had scuttled his marriage to his high school steady. Dalton was on his way, but the way was down.

"Then I joined the military in 1973 and started experimenting. All kinds of pills, mostly uppers to keep us awake in training classes after we'd partied all night. We'd buy pills in the streets and smoke dope in the cornfields. Later, overseas, it was drug and drink, every day, all day. Stay only sober enough to cover the job. I got out in '77, stayed in California working for Rockwell, then Northrop — non-destructive test jobs — and still drugging and drinking. I finally terminated myself and went back to Texas."

A three-month minimum-wage job followed, then a year as a night-shift pipe inspector at a tool company. When an ex-drinking buddy told Dalton about openings on the F-16 line, he applied to GD and was hired in April 1980. On his birthday that year he remarried and brought his wife up from Austin.

"I never used cocaine until I came to Fort Worth. And I drank heavy as ever. There was no stopping. We'd split a pint of cognac for lunch and pick up another one after work. Weekends it was a half-gallon. Not bad for a guy who started on Thunderbird at \$1.98 a bottle. I'd graduated. And there was always beer. By the case. The rule was drink until empty. No leftovers.

"I was laid off in '84 during the strike, then got my job back through arbitration. I had more money in my pocket than I'd ever seen in my life. I flew to Jamaica, bought drugs, booze, and partied for six days. When I came home, my wife told me: 'Go back where you've been or go get help.' It took me an hour and a half to decide. Thirty minutes later I was in Fort Worth's CareUnit hospital and 32 days after that I came out clean. That was November '85 and I've been straight ever since."

Today, Dalton, a non-destructive test inspector, gives up his lunch hour every Tuesday to lead meetings for employees referred under the company's Employee Assistance Program. Two other nights each week he's an Aftercare counselor at CareUnit — and vice president of the facility's "Alumni" group.

"I see myself — the old me — in a lot of people. Alcoholics and addicts need a push. Don't expect them to volunteer for help. It's 'Hey, I'm OK. My free time is my own. Don't pick on me!' But what you do on a Sunday affects you on a Monday. I know. And if you're an alcoholic, it just goes on and on. Drug users don't even know if they're snorting cocaine, Ajax or baking powder. It's only what the Street says it is — and it could kill.

"My dad and his dad were alcoholics. I have three

stepbrothers who are alcoholics — and drug addicts. I'm trying to keep my son from being an alcoholic. For me, it's still an hour at a time. Even after almost five years, every day's not good for me. The thought is always there.

"My drinking buddy turned out not to be such a buddy. Now, my wife is my best friend. I thank her and I thank the company for giving me a second chance. And I thank God every day for helping me."

For Jimmy D., who joined GD in 1981 after 26 years of chronic drinking in the military, the trip back also was triggered by his wife.

"I'm what they call a dinosaur," says Jimmy. "Straight booze. No drugs. That's rare today. I went through two wives. Lost my house, kids, car, you name it. Actually, I only drank when I was alone. Or with someone. Or when I was happy. Or sad. Or when the cat had kittens.

"Four years ago, I married again. My hometown sweetheart — we're talking 35 years back — we both still carried a spark. But unlike my other wives, she didn't share my need to drink every day. 'Hey,' I'd tell her. 'That's a very stressful job out there at GD!'

"One night in March 1987 we had an argument and I bailed out. Had about 10 rums, my favorite. I'd been trying to cut down and when I woke up with a headache I was insulted. 'That's terrible,' I thought. 'I only had 10!' The next day after work I found a note propped up on my rum bottle: 'RUM HAS WON. RUM IS NO.1 AND I'M NO. 2.' Of course, I denied it. I always did. 'Honey,' she said, 'you need help.' And that's when I opened my mouth and someone else's words came out. 'You're right,' I said.

"I had my last drink on March 9 and entered the CareUnit on the 13th. But I had my private little wall up to the last. When they told me what it would cost to get help, the wall went right up to the ceiling. When they said GD's insurance program would pick up 80% of it, the wall finally came down. I'll be forever grateful to the company for putting me through that treatment center. Because it sure straightened my life out."

Three years later, Jimmy is a regular CareUnit counselor and president of the "alumni" group. Like Dalton, he has several close family members who are alcoholics. ("Heredity plays a big part in this," Jimmy says.) And like Dalton, he gives credit for his rescue to what he calls "a higher power."

"This is a spiritual thing," he says. "It takes what I call HOW: Honesty, Open-mindedness and Willingness."

A senior logistics engineer working on special projects, Jimmy thinks drug and alcohol abuse needs more visibility and more action. "It's a big war out there. People want help, but they need a push."

Twenty-five days after entering the CareUnit in 1987, Jimmy wrote a letter. "Dear God," he wrote. "Since I've been here, I've had time to think. ... I knew you were there when... I almost drowned as a child and when I could have been killed in Vietnam. I know that alcohol... gave me an illness that I alone cannot control. ... Thank you for keeping me sober and please guide all addicts in need of help."

... Peter K. Connolly

Outstanding service earns honors for 12 at Pomona

Twelve employees recently received Pomona's Awards for Excellence, the highest honor given by the division, for outstanding service in their particular fields.

Winners at Pomona were Ron Rheude, administration; Ed Miyashiro, engineering; Gary Burke and Duane Hawkins, total quality management-concurrent engineering; Derek Andrews, material; John Gross Jr., production; and Gordon Vanus, quality, Navajo Facility in Window Rock, Ariz.

At the Camden, Ark., Facility, the winners were Robert Gilreath, material; Mike Powell, engineering; Larry Kerley, product assurance; Cynthia Skidmore, material; and Paula Wilson, production.

Criteria for winning the Excellence Award include outstanding performance in a selected category such as material, administration, engineering and management, acceptance by peers and fellow workers, company dedication and professional involvement.



Willie May Jones, an electronics assembler at Valley Systems, puts together a battery coolant unit for Stinger as Maj. Gen. Donald M. Lionetti, commander of the Army Air Defense Artillery Center at Fort Bliss, Texas, watches.

Valley Systems amasses 64 percent of first Stinger contract competition

Valley Systems Division has won the major share in the first competition for production of Stinger anti-aircraft weapons.

The division was recently awarded 64 percent of an add-on to the fiscal year 1989 buy of Stinger-Reprogrammable Microprocessor missiles. The remainder went to Raytheon, which had qualified as a second source of Stingers. Stingers had been made solely by General Dynamics.

The Valley Systems award is a \$68 million firm fixed price production contract for 2,458 missiles and 50 guidance assemblies. The division now has contracts to produce more than 30,000 Stinger-Reprogrammable Microprocessor missiles.

Work under the new contract is to be completed by Aug. 31, 1992.

The award is a significant milestone in ensuring continuing production of Stinger at Valley Systems, according to Bill Leonard, vice president-Stinger weapon systems.

"Winning a major share of the competition is a

tribute to the collective hard work of the entire Stinger team at Valley Systems," he said. "The Army recognized the important contributions made by division employees in reducing the cost of producing a reliable weapon. Our experience in developing and producing Stinger was also a contributing factor in our being selected."

Production of Stinger at Valley Systems reached an all-time high of more than 700 per month in 1989. The Stinger system traces its roots to Redeye, the world's first man-portable, short-range air defense missile. Including both Redeye and Stinger, General Dynamics has produced this type of air defense weapon since 1965, first at Pomona Division and now at Valley Systems.

The Stinger-Reprogrammable Microprocessor is a passive infrared/ultraviolet homing fire-and-forget missile designed to provide cost-effective, highly lethal air defense. All of the U.S. armed forces and several allied nations use Stingers.

■ Jerry Littman

Company teams with British Aerospace

General Dynamics and British Aerospace plc of the United Kingdom have agreed to cooperate on international projects in defense procurement and technologies.

"Both of our companies recognize that the changing global security environment necessitates increased transnational industrial collaboration," read a joint statement by the corporations. "Both of us possess complementary capabilities, which can be combined to meet defense needs in the United States, the United Kingdom and other countries."

The statement followed the signing of a memorandum of cooperation by Stanley C. Pace, General Dynamics chairman and chief executive officer, and Dick Evans, British Aerospace chief executive.

Under the agreement, British Aerospace will assist General Dynamics in promoting industrial arrangements and programs to explore products, industrial investments, technology transfers "and other programs, which might promote sales or lay the foundation for other collaborative projects."

The companies will establish an agreement between

General Dynamics Land Systems Division and British Aerospace's Royal Ordnance subsidiary as an initial venture. To the extent that it is economically feasible, General Dynamics will use Royal Ordnance as a subcontractor to integrate the M1A2 turret for the proposed sale of the M1A2 tank to the United Kingdom Ministry of Defence. The M1A2 is one of several vehicles being considered for the British Army's new main battle tank.

General Dynamics will also support Royal Ordnance as the principal ammunition supplier for this program for sales to the British Army and for other sales of the M1A2. A decision in the British tank competition is expected before the end of this year.

General Dynamics also will attempt to assist Royal Ordnance in overseas sales of its M119 light howitzer. Royal Ordnance and General Dynamics would "work together to assure maximum United Kingdom content of such sales in return for maximum General Dynamics content of M1A2 sales in order to achieve greater value for money and a balanced industrial participation between the two companies."

Land Systems joins Teledyne to compete for armored gun

Land Systems Division has teamed with Teledyne Continental Motors General Products to compete for a contract to build the Army's new Armored Gun System.

The system will provide the Army's light forces with improved 105mm firepower. The system will be mounted on a chassis that can be dropped by parachute, or without parachute at low altitude and speed, from C-130 Hercules cargo planes.

The prototype vehicle built and tested by Teledyne has demonstrated the ability to meet all of the Army's anticipated requirements. Land Systems and Teledyne will use off-the-shelf technology for initial limited quantities and to make the system attractive for additional orders.

The Army has not requested proposals or announced acquisition plans. However, production is expected in the mid-1990s. The Land Systems-Teledyne team will establish a jointly staffed program office to pursue the contract.

Abilene Facility opens manufacturing annex

General Dynamics' Abilene Facility recently opened a 105,000-square-foot manufacturing annex in a ceremony attended by hundreds of employees and guests.

Bill White, Abilene's general manager, called the event "an important day for General Dynamics and for Abilene."

General Dynamics is a major employer in Abilene, part of a region of Texas hit hard by the oil industry's decline.

The addition will handle machining work relocated from Fort Worth Division to create factory floor space for manufacturing projects required by new aircraft programs.

Safety-conscious drivers cited

Material Service Corp. employees with long records of safely driving ready-mix concrete trucks were recently cited by the National Safety Council.

Awarded for 30 consecutive years without a preventable vehicle accident were Gene Rzepka and Kenny Schwarz. Ed Ptacin received the 25-year award. Twenty-year recipients were Don Demuro, Jack Newborn and Ron Soltis. Four drivers accumulated 10-year safety records: Art Dennis, Dana Gloor, concrete-pipe driver Merl Halom and Janet Stoppenbach.

In addition, 11 drivers had more than 25 consecutive years without a preventable vehicle accident: Frank Wolf, 34 years; Don Barbaras and George Teslicka, 33; Andy Camugnar, 32; Lenny Sattler, 31; Bob Jackson and Henry Stephansen, 29; Bob LaShure, Gene Lewandowski and Ron Parzygnat, 27; and Bill Lange, 26.

Photo Contest II

(Continued from page 1)

address and home and work telephone numbers should be written on a piece of paper taped to the back of the photo. A description of the photo — where and when taken, and with what equipment — would be helpful.

- A self-addressed (not stamped) 8x10 envelope and a cardboard stiffener should accompany each entry.
- Photo negatives must be available on request.
- No special darkroom effects are allowed.

Entries should be sent to Contest, Public Affairs Office, General Dynamics Corp., Pierre Laclède Center, St. Louis, MO 63105. Call (314) 889-8564 for more information.

General Dynamics flashback



Electric Boat built the USS Skipjack for underwater speed.

Historic sub's diving days are done

After sailing over a million nautical miles and making 1,280 dives under 13 commanding officers, the oldest operating Navy nuclear submarine has retired.

USS Skipjack (SSN 585), launched more than 32 years ago at Electric Boat Division as the fastest submarine of its day, was decommissioned recently at Norfolk (Va.) Naval Station. The event ended the career of the lead ship of a new class of fast-attack submarines that introduced a hull shape and a propulsion system employed in almost all subsequent U.S. attack and ballistic missile subs.

Although USS Nautilus (SSN 571), launched in 1954, was the first nuclear-powered submarine, some "carrier admirals" were unimpressed. But when the high-speed Skipjack, with a reactor twice as powerful as that of the Nautilus, kept pace with fast carriers and "sank" them during maneuvers, the last skeptic of nuclear propulsion was convinced.

SSN 585 was one of six Skipjack-class submarines, and one of two built by Electric Boat. Its special teardrop hull was designed after the Navy's first submarine, the Holland, commissioned in 1900. The shape gave Skipjack greater underwater speed than earlier subs, whose pointed bows were built for surface sailing. Skipjack was stripped of any projections and everything on its superstructure was recessed or made retractable to reduce drag.

Skipjack raced to an underwater speed record during sea trials on March 8, 1959, a mark that stood 18 years until the advent of the Los Angeles-class submarines.

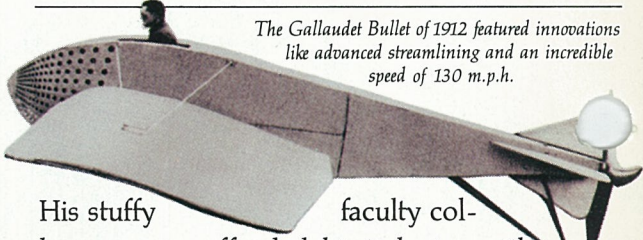
During its shakedown cruise in August 1959, it became the first nuclear ship to pass through the Straits of Gibraltar and operate in the Mediterranean Sea. Skipjack also made a record submerged Atlantic transit in 1962.

Skipjack's propulsion system was hailed for its innovations when the boat first went to sea under Lt. Cmdr. William W. Behrens Jr. But the system also caused problems. The sub's noisy high-speed turbines, pumps and gears gave it the sound of an underwater locomotive. Still, it served as a front-line submarine and was equipped with an experimental sound quieting system in 1977.

The third submarine to bear the name since 1911, Skipjack was deployed to all corners of the world participating in advanced exercises and demonstrating the capabilities of nuclear power. Skipjack earned the Battle Efficiency "E" rating four times, participated in four South American deployments, eight Mediterranean Sea deployments and seven North Atlantic NATO exercises, and visited 22 nations.

■ Myron Holtzman

HE WASN'T
A WRIGHT BROTHER.
BUT HE HAD
THE RIGHT IDEA.



The Gallaudet Bullet of 1912 featured innovations like advanced streamlining and an incredible speed of 130 m.p.h.

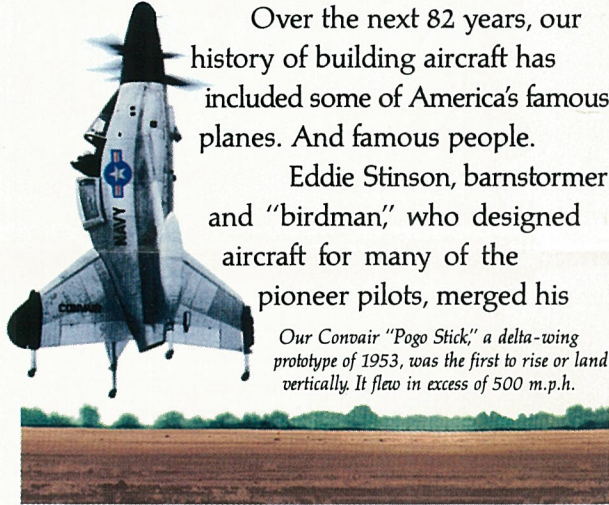
His stuffy faculty colleagues were offended: his tinkering with "foolish flying gimcracks" was "undignified."

But young professor Edson Gallaudet was willing to give up his dignity, and his job, for a new idea about warping the wings of flying machines.

In 1898, he tested a scale model which proved his idea right. And five years later, Wilbur and Orville Wright flew using that same principle.

Today Gallaudet's model is in the Smithsonian, one of two monuments to Gallaudet's inventiveness and persistence. The other is our company.

In 1908, Edson Gallaudet started what many credit as the first aircraft factory in America. Gallaudet Engineering Company became the earliest aircraft ancestor of General Dynamics.



Over the next 82 years, our history of building aircraft has included some of America's famous planes. And famous people.

Eddie Stinson, barnstormer and "birdman," who designed aircraft for many of the pioneer pilots, merged his

Our Conair "Pogo Stick," a delta-wing prototype of 1953, was the first to rise or land vertically. It flew in excess of 500 m.p.h.

It's showtime: Air Force's Thunderbirds mix grace, glamour and Fighting Falcons

The Air Force Thunderbirds flew their red, white and blue Fighting Falcons back to Fort Worth recently and performed two air shows that attracted a record 1.1 million persons to the Carswell Air Force Base open house.

The T-Bird F-16s were piloted through their high-performance precision aerial routine over the same runway from which they made their initial flights in 1982, when Fort Worth Division delivered the new airplanes to the Air Force demonstration squadron.

The F-16s have each logged more than 2,000 flight hours and have thrilled more than 75 million people since taking to the air in their first public show with the Thunderbirds in April 1983.

The Carswell performances showed why the aircraft and maneuvers are as popular today as seven years ago.

The demonstration opened with an upbeat public address greeting by the team's official narrator, Maj. Tim Hoy: "Welcome to 30 minutes of superb precision flying...taking the Air Force story to the American people."

Minutes later, the speakers carried the voice of Lt. Col. Chuck Simpson, commander of the team, speaking from his cockpit at the foot of the runway: "Let's run 'em up...release brakes...burners...ready...now."

As four of the Thunderbirds made an afterburner takeoff in formation, Hoy commented that their com-

bined thrust exceeded the horsepower of 1,000 automobiles. Simpson and Maj. Chuck Greenwood, the lead solo pilot, followed seconds later to complete the six-aircraft team.

For the next half-hour, trademark T-Bird maneuvers followed in rapid succession: the split S, clover/loop, knife-edge pass and calypso pass, all announced by Hoy. Crowd favorites, judging from cheers and gasps heard even over the jets, were the startling crossover-break and high bomb burst. Several maneuvers, such as 9-g, tight 360-degree turns, showcased unique capabilities of the Fighting Falcon.

Hoy's narration emphasized that every Air Force F-16 pilot learns all the show maneuvers as part of standard training for aerial combat. In fact, the Thunderbirds are an operational fighter squadron. Their airplanes can be converted to a combat configuration within 48 hours.

The Thunderbird pilots visited Fort Worth Division for a walking tour of the F-16 production line on the Monday following the weekend shows. Accompanied by former T-Bird pilot Tim Roels, Fort Worth's director of F-16A/B/N programs, they took time to chat with employees and sign hundreds of autographs.

Simpson discussed the Fighting Falcon, which he has been flying in various Air Force assignments since 1982: "It's a real pleasure to fly, and it's a great airplane

to show what the Thunderbirds want to show. We can use brute force if required, or we can take that brute force and make it look very graceful.

"We're very proud to be flying F-16s, and I hope the employees of General Dynamics are equally proud to be building them."

■ Joe Stout

► All six Thunderbird aircraft fly in tight formation.

Thunderbird show dates

The Thunderbirds are scheduled to perform more than 70 shows in their 1990 season, which ends in November. Some of the remaining performances near General Dynamics facilities:

Place	Date
Battle Creek, Mich.	June 19-20
Hill Air Force Base, Utah	June 23
Mansfield, Ohio	July 4
Traverse City, Mich.	July 11-12
Dayton, Ohio	July 21-22
Otis Air Force Base, Mass.	Aug. 19
Harlingen, Texas	Oct. 12-13
George Air Force Base, Calif.	Nov. 11



company with ours. As did Jerry Vultee, whose planes set many distance and speed records, including Jimmy Doolittle's 12-hour cross-country flight.

During WWII, the Consolidated B-24 Liberator went from plan to finished plane in a record nine months and became the most-produced American bomber. After the war, our B-36 Peacemaker became the backbone of America's Strategic Air Command.

Our innovative, delta-wing design made the F-102 the world's first supersonic interceptor. And the B-58 Hustler the world's first supersonic bomber.

Today our F-16 Fighting Falcon is rated

the finest fighter in the world. It well represents our long tradition of craftsmanship and creativity.

Once again, that tradition is about to be tested. In a technology competition against groups from



The RB Racer, made by Dayton-Wright Airplane Company, was the first aircraft to have fully retractable landing gear. Dayton-Wright became an early part of General Dynamics.

West Germany and Japan, General Dynamics is teaming with four top American companies to develop the National Aerospace Plane.

To fly from runway to orbit, at speeds up to 17,000 m.p.h., we must invent new science. We must also invent new ways for American competitors to work together. But we are confident.

Since the days of Gallaudet, our company has been inventing not only better airplanes, but better ways to make them.

GENERAL DYNAMICS
A Strong Company For A Strong Country



Company awards five scholarships

Five children of employees have been named for awards under General Dynamics' improved college scholarship program.

The recipients are Alison Andrews, Katherine Chen, Jason Lee, William Shih and Andrew Staugler. Andrews, Lee and Staugler received \$5,000 scholarships based on grades and financial need. Chen and Shih were given \$1,500 awards based on scholarship alone. The amounts were increased this year from a previous maximum of \$3,000. This is also the first year that the program has been administered by Citizens' Scholarship Foundation of America, Inc.

Andrews attends Stonington High School in Pawcatuck, Conn., and has won numerous awards in English, French, history, mathematics and science. She is the daughter of Denzel Andrews, who works in engineering at Electric Boat Division in Groton, Conn.

Chen is a student at James Martin High School in Arlington, Texas. Her awards include the National Honor Society Certificate of Merit and the Kiwanis Award for Academic Excellence. She is the daughter of Chu-Shiang Chen, who is in engineering at Fort Worth.

Lee attends Diamond Bar (Calif.) High School. He has won several regional journalism and national writing awards and teaches German at an elementary school. Lee intends to major in engineering. His mother, Shirley Lee, works in production at Pomona Division.

Shih is a student at Gompers Secondary School in San Diego. He has won first place for the last three years at the San Diego Science Fair. Shih will attend Harvard University as a biology or biochemistry major. His father, Peter Shih, is in engineering at Convair.

Staugler attends Shawnee High School in Lima, Ohio, where he is a National Merit Commended Scholar. Staugler has been accepted at Pennsylvania State University and wants to major in aerospace engineering. His father, James Staugler, works in human resources for Land Systems.

Students who are children of current, retired or deceased General Dynamics employees and who plan to major in engineering, physics, mathematics, chemistry, computer science or business are eligible for the company's scholarship program.

Gregg, Panciera picked for Sloan program

Kirk P. Gregg of Convair Division and George P. Panciera of Data Systems Division-Eastern Center have been selected as General Dynamics' recipients of scholarships to the Alfred P. Sloan Fellows Program.

The program puts participants through intensive studies leading to master of science degrees in management from the Massachusetts Institute of Technology and Stanford University. Gregg and Panciera were selected by General Dynamics executives from a group of six employees.

Gregg will enter the 12-month Sloan program at the Massachusetts Institute of Technology. Panciera will study in the 10-month program at Stanford.

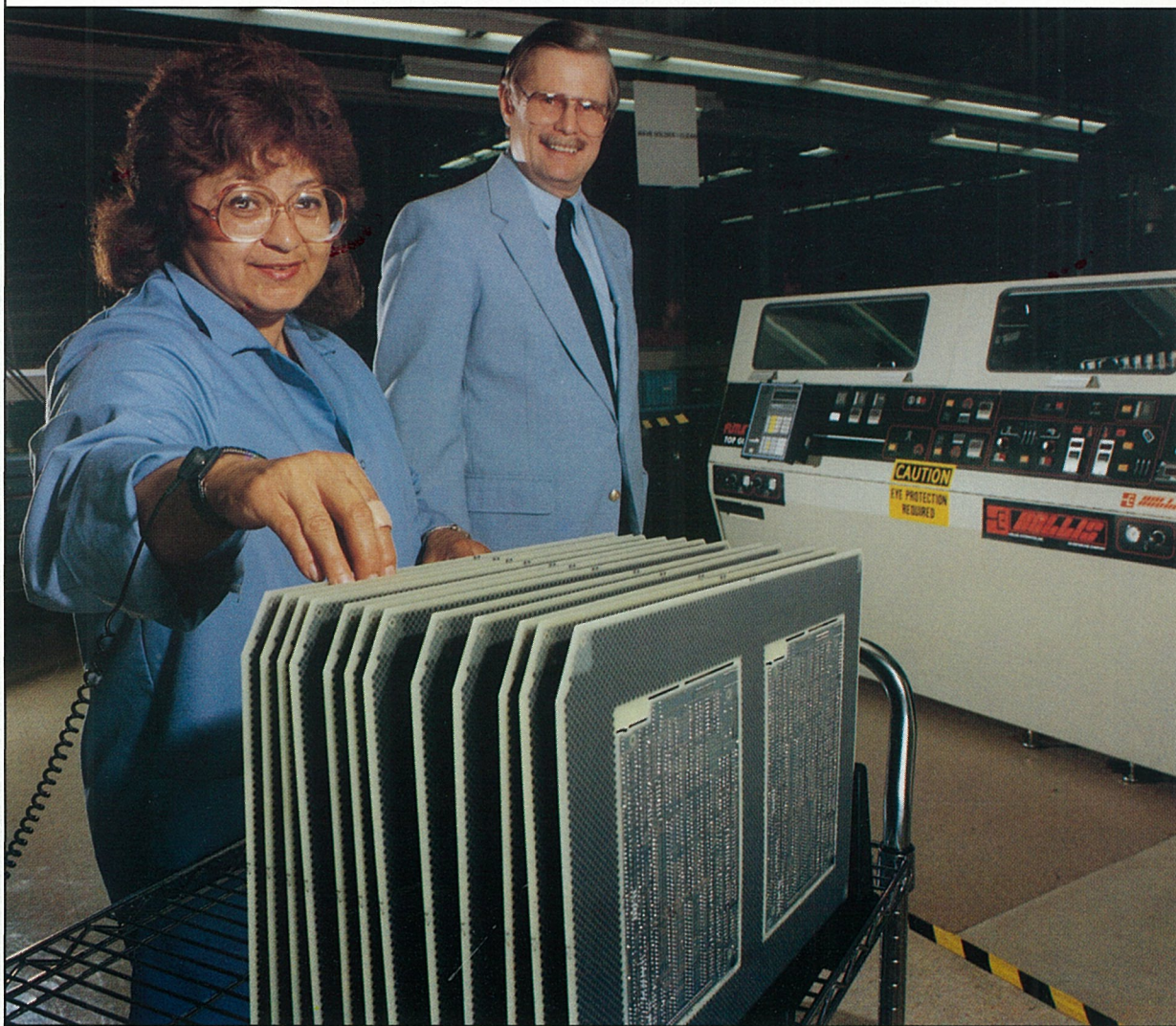
Gregg, 30, a human resources program manager, has worked for General Dynamics for seven years. He has a bachelor's degree in experimental psychology from Bemidji State University and is completing a master's degree in industrial relations from the University of Minnesota.

Panciera, 36, is manager-computer-aided design/computer-aided manufacturing. He has nine years' experience with General Dynamics. He holds a bachelor's degree in structural engineering from Cornell University and a master's degree in computer science from Rensselaer Polytechnic Institute.

Others considered for the Sloan program were John Gruzca, Electronics Division; Terence J. Plaza, Pomona; Craig G. Andersen, Data Systems-Central Center; and David K. Rock, Land Systems.

For the first time since General Dynamics began awarding Sloan scholarships, two runners-up were also enrolled in educational programs. Gruzca will go to the University of Michigan for a one-week course. Plaza recently completed a weeklong course at the Wharton School at the University of Pennsylvania.

CASE STUDIES



Operator-in-training Emelia Regalado and Bill Sumner are going for zero-defect wave soldering at Electronics Division to make circuit boards, such as those on the cart, more reliable.

Solid solders make boards safer

Bill Sumner at Electronics Division plays a computer game at home that illustrates the importance of quality in products built for the military.

In the game, he "flies" a fighter aircraft that sometimes flashes a signal that his weapon of choice "malfunctioned" and he is unable to attack despite having the "enemy" in his sights.

Sumner, a senior manufacturing engineering specialist in charge of soldering operations at one of Electronics' manufacturing facilities in San Diego, is determined that no printed circuit board coming out of his shop will ever fail in the field due to a soldering defect.

A technical briefing on the soldering process described here is available by calling Sumner at (619) 592-5534.

The operation builds complex, multilayer boards with 7,000 solder joints and between 300 and 400 components per board — more complex circuitry on one board than inside a television set. So far he and his machine operator, Luigi Ursino, and operator trainee Emelia Regalado have not lost a single board during manufacture and their defect rate is averaging about 200 parts per million, an industry measurement that indicates near-zero-defect work.

To maintain this level of quality, Sumner and his team have mastered the operation of a wave soldering machine with some state-of-the-art tools that allow them to correct defects as soldering is in process and to get control over a parameter that is hard to nail down consistently and repeatedly — the preheat control.

"Most wave-soldering parameters are easy to control, monitor and document, permitting a consistent, accurate and repeatable process," Sumner said. "The exception is preheat. We can control process speeds and solder temperature and height, but the normal thermal instability inherent to most solder machines makes preheat control very difficult."

An analogy is the home oven. When the Thanksgiving turkey is placed in a preheated 350-degree oven, the cold object drops the temperature and more heat is needed to regain 350 degrees.

The wave solder machine uses an instrument called an infrared pyrometer to measure the temperature of the board instead of the temperature of the heat zone inside the machine. With the aid of a computer pro-

gram, the operator then compares the temperature profiles of each type of board soldered to the first article of its type already soldered. All other parameters in control, the temperature profile tells the operator whether the solder will be good.

Sumner calls it real-time statistical process control. In a low-volume, high-mix operation — 75 different types of boards and a rate of between 30 and 50 boards per day — the operation cannot afford to incur wave solder defects to generate traditional statistical process control data. "We have to know as we're soldering that the first board — every board — is right," he said.

A fundamental principle of total quality management is the use of state-of-the-art tools. Near-zero-defect wave soldering would not be possible without a tool called a hot airknife, according to Sumner.

The hot airknife exposes or corrects soldering defects such as excess solder, solder bridges or solder dewetting much the same way as hot air blowers remove water from a car's surface in a car wash. Many defects that are normally difficult, and in some cases impossible, to detect without the use of a microscope are easily located. Inspection after wave soldering is simplified; expensive and sometimes harmful rework is prevented; and hidden circuit card defects are avoided.

The bottom line for Sumner is that military hardware is less likely to fail.

"The wave solder operation is an outstanding demonstration of process ownership," said Mark Frazier, division vice president-quality assurance. "The employees have full control of their processes and are empowered to stop the operation at any time to change it. The quality of their work shows the level of their commitment."

The key is training. Extensive training is essential for an operator to not only run the machine but also to maintain the process. Regalado has begun training. Ursino has 2½ years' experience.

"Soldering is a tremendously variable process," Sumner said. "Machine-controlled processes do not run by themselves. The operators are trained to do more than just follow machine instructions. They must be fully cognizant of the process in order to recognize and correct subtle process deviations before multiple defects occur."

■ Julie Andrews

GD first: Valley Systems reuses all wastewater

Valley Systems Division has become the first General Dynamics division to reach the company's goal of zero discharge of hazardous wastewater by recycling its industrial water through the world's largest system of its kind.

The unique ozone wastewater industrial treatment operation establishes the Rancho Cucamonga, Calif., facility as an environmental leader in regulatory compliance, application of advanced technology and water conservation.

Multiple waste streams from industrial processes are recycled for cooling the division's air conditioning and for use in electronics manufacturing. The system is designed to treat 35,000 gallons of wastewater per day, but can handle up to 150,000 gallons per day. By comparison, an average swimming pool filter treats up to 24,000 gallons of water per day.

Approximately 2,800 feet of piping have been installed between the ozone treatment plant and the division buildings it serves to carry the wastewater and return the treated water.

"The system is quite an achievement of which all employees can be proud," said John Grosskopf, manager-environmental resources management. "The division took a leadership role and sought out an advanced technology that would allow us to recycle all of our industrial wastewater without discharging to the sewer."

Water recycling is especially important because California is in the fourth year of a drought condition. Many communities, including nearby Los Angeles, are likely to pass emergency water conservation measures.

The division is also under a strict mandate to comply with clean water regulations enforced by the Cucamonga County Water District and the federal Environmental Protection Agency.

The division's environmental resources management and facilities departments selected the treatment process



A bank of four filters are installed during construction of Valley Systems' ozone industrial treatment facility. The filters remove solid contaminants from wastewater. The system has eight banks with four filters each.

developed by Ozone Systems Inc. of El Cajon, Calif. Construction started last September.

The system is part of the division's commitment to make its products in a manner that is well within all legally specified environmental limits and that has no impact on the environment or keeps the impact to the lowest feasible level, according to Len Stuessel, vice president-production.

The system mixes industrial wastewater with ozone in the presence of ultraviolet light in a reaction chamber. In that chamber, any organic contaminants such as solvents are destroyed. Any inorganic chemicals are

converted to more stable forms that precipitate from the water.

The waste stream from the chamber is sent through an intricate filter system where virtually all of the waste solids are removed. The clean water is recycled into the industrial process water circuits.

"With our continued commitment to hazardous waste management, Valley Systems Division will continue to be a leader not only in the development and production of missile systems, but also in eliminating pollutants from our facilities," Stuessel said.

■ Jerry Littman

Savings and stock investment plans

Annual rate of return for the 12-month period ending:

	April 1988	April 1989	April 1990
Salaried			
Government bonds	7.5%	7.3%	7.6%
Diversified portfolio	(7.9)%	26.1%	10.0%
Fixed income	11.1%	10.6%	10.1%
Hourly			
Government bonds	7.7%	7.5%	7.7%
Diversified portfolio	(8.1)%	26.6%	10.2%
Fixed income	11.0%	10.6%	10.1%
GD stock closing price	\$54.87	\$55.87	\$34.75

() Denotes negative number.

Material Service helps fund students

Jack Michelson had been working full-time so he could attend the University of Illinois at Chicago. While his job provided enough money for tuition, and he managed a perfect 5.0 grade-point average last fall, Michelson had only enough time to take a couple courses at once.

But that has changed, thanks partly to a grant from the school's Industrial Scholars Program funded by Material Service Corp. and other Chicago firms.

Each year the top students in the school's department of civil engineering, mechanical and metallurgy are given awards. This year 10 students received \$500 awards. Michelson, a junior majoring in civil engineering, was one of the 1989-90 recipients.

"As one of the recipients, I can personally tell you that the award is of great significance to my overall financial situation," Michelson said. "In fact, I was able to quit working full-time and study more."

As a full-time student, he was eligible to apply for a University Scholarship Association award of \$1,000. He received the award. He also entered the Honors College and Tau Beta Pi Honor Society and made the dean's list.

High-tech concrete attracts Soviets

It's no surprise that Soviet researchers would travel to Chicago, a city internationally known for its concrete construction, to learn more about their own concrete.

A three-member team of Soviet concrete researchers brought their own material on a recent visit to the research and development laboratories of Material Service Corp., internationally known as an innovator and leader in concrete construction technology.

A series of rigorous tests were conducted on the Russian material by Material Service personnel. The testing included durability, strength gain, shrinkage and elasticity.

"We first learned about their cementitious material when the Portland Cement Association contacted us," said John Albinger, Material Service general manager-technical customer service. "The association recommended that the Soviets visit Material Service because of our advancements in high performance concrete."

"We invited them to come to the United States and use our laboratory to conduct tests to evaluate the performance and compatibility of the Soviet materials with concretes designed and manufactured by Material Service and with cements and additives already on the market."

The Soviets also "studied" Chicago culture. The group discovered Chicago pizza and hot dogs, visited Chicago's Greek Town, spent an evening fishing smelt on Lake Michigan, and watched a National Hockey League playoff game between the Chicago Blackhawks and the St. Louis Blues.

The group also visited a pour of Material Service's "super high strength" ready-mix concrete that achieves compression strengths of more than 16,000 pounds per square inch, about four times the strength of concrete used in typical building construction. The pour was the first time concrete of this strength was delivered in Chicago.

This was not the first time that Material Service worked with the Soviets. The company's technical marketing manager, Jaime Moreno, met with Russian concrete researchers at a recent conference in Moscow.

Material Service representatives have participated in similar exchanges with other countries, including China, France, Mexico and Venezuela. The visit to Mexico came in the wake of the country's devastating earthquake to document and analyze its effect on concrete structures.

■ Peter Stamos

Kirkland spreads environmental message

Earth Day lasted more than three weeks for John Kirkland.

Kirkland, manager of environmental resources at Electric Boat Division, worked with the division's communications department to tell the community about company environmental efforts. Kirkland's work began shortly before Earth Day April 22 and ended in mid-May.

Electric Boat's Earth Day observance began a day ahead of the real thing when Kirkland participated in a two-day, citywide exhibit at the Groton, Conn., Senior Center.

The display included photos and explanations of the bilge water waste treatment facility, plans for the division's hazardous waste incinerator, the corporate environmental mission statement and handouts for the

200 people who attended each day.

During the following week Kirkland traveled to nearby Mohegan Community College in Norwich to take part in a wide-ranging environmental panel discussion. A day later, he played host to 11 members of the Environmental Awareness Club from St. Bernard's High School in Montville.

In May, Kirkland, with the support of the communications department, gave a one-hour presentation on the environmental commitments of Electric Boat and the rest of General Dynamics during a special program focusing on Earth Day held at E.O. Smith High School in Storrs. More than three weeks after the actual event, Kirkland's Earth Day-related duties ended with an environmental overview he presented to students from New London's Connecticut College.

■ Dan Barrett

'House That Ruth Built' has relocated to San Diego

Yankee Stadium, Polo Grounds stand upstairs

Tom Edwards regularly visits the old Polo Grounds.

To get there, the senior maintenance engineer at Space Systems Division climbs the stairs to the "Baseball Room" at his home in San Diego and parks himself in one of two rows of seats saved from the legendary New York baseball stadium, which was torn down in 1963. He has painstakingly restored the wrought iron and wood seats from the ravages of 54 New York winters.

"I can sit in these chairs and still hear the roar of the crowd," Edwards declares. If the chairs don't stimulate nostalgic memories, the rest of the Baseball Room will. It's full of cards, paintings, books, videos, old programs and yearbooks, photographs, statues, plates, signed baseballs, caps, uniforms and bats.

Edwards is the ultimate baseball fan. He collects anything and everything connected with the three original New York baseball teams — the Yankees (his favorite), the Brooklyn Dodgers and the Giants. He hopes to trade some of his Polo Grounds seats for Ebbets Field seats, which would give him a piece of all three of the old New York playing fields. A chunk of bleachers from Yankee Stadium — "The House That Ruth Built" — already adorns one wall.

"Like most people, I started collecting cards when I was a kid," Edwards says. "I got my first baseball card in 1958. My parents had moved to Red Sox country, but being from New York, I still traded for Yankees cards."

A childhood hobby was forgotten as Edwards left home, went into the service, did a tour in Vietnam, returned to civilian life to obtain two degrees, and started a career with General Dynamics at Electric Boat. In 1978 he transferred to Convair and then Space Systems, where he oversees work in progress on the division's facilities. His wife, Cathy, is a senior engineer-



Tom Edwards and wife Cathy, a senior engineering illustrator for Electronics Division, pose with one of the old Polo Grounds seats.

ing illustrator at Electronics Division.

An ultimatum from his mother forced him to move his baseball memorabilia to San Diego, and the adult Edwards rediscovered his treasures — like the newspaper account of Roger Maris' single-season record 61st home run and the scorecards, yearbooks and cards that are the foundation of his collection.

Edwards once again began collecting cards, including "tobacco cards," the smaller cards that were packaged

with cigarettes around the turn of the century. He has completed several sets of tobacco cards of his three New York teams. He branched into other pursuits as baseball cards became too pricey.

"What was a \$15 card in 1980 is now in the \$400-\$600 range," he says. "Baseball card trading is no longer just for kids. We're talking about big kids' toys. In 1989 there were \$1 billion in sales of new cards alone."

A 1952 Mickey Mantle in mint condition, for example, is worth about \$10,000, according to Edwards.

Edwards began collecting other baseball memorabilia and also started handling sports photography and writing for several nationally distributed baseball publications. He still attends baseball card conventions, where he has met many baseball stars. Because this year is the 100th anniversary of the Dodgers, many of the old stars from Brooklyn days are making personal appearances.

The most interesting baseball person Edwards has met was Lou Dials, star player with the New York Black Yankees and Homestead Grays in the old Negro League, the only top league open to black players before Jackie Robinson joined the Brooklyn Dodgers in 1947. Dials gave him one of his old bats — "a serious piece of lumber," according to Edwards.

He also recently tracked down Paul Otis, who played with the New York Highlanders, precursor to the Yankees. Edwards saw an item in the sports page that Otis was celebrating his 100th birthday at a nursing home in St. Paul, Minn. "This is a man who got a hit off Walter Johnson," Edwards says.

"I do this because it's fun meeting people," Edwards says. "It's not just accumulating new pieces."

Now that Edwards is in San Diego, he roots for the Padres. But if a World Series ever comes down to the Yankees and the Pads? Well, he would don his Yankees cap and just take his chances at Jack Murphy Stadium.

■ Julie Andrews

GD walkers wind up with \$215,000 for March of Dimes

Supposedly everything's big in Texas, and big is a good way to describe the role played by General Dynamics' Texas contingent in the March of Dimes' WalkAmerica events held throughout the United States in late April.

At Fort Worth, 1,575 General Dynamics employees, family members and friends raised more than \$136,500 in pledges in the local WalkAmerica. Those figures represent about half the total participants and pledges in the 18.6-mile event that began and ended in the city's historic Stockyards district.

The Fort Worth turnout helped General Dynamics employees nationwide collect more than \$215,000 in pledges, double the amount raised by company workers in last year's WalkAmerica. The money helps the March of Dimes fight birth defects.

San Diego employees gathered the second largest amount of pledges at a single General Dynamics location. A total of 1,044 people turned in \$55,000.

Fort Worth workers did more than just walk in the their event. In addition to the walkers, about 100 volunteers staffed pace vans, watering stops and lunch areas. Employees also helped decorate the Stockyards.

W.B. "Zim" Zimmerman, Fort Worth Division vice president-logistics and support, was the county chairman for the event, called TeamWalk in Fort Worth. Other employees headed committees responsible for publicity and special events. The company also provided a stage and sound equipment for ceremonies at the finish.

The division encouraged employee support by offer-

ing \$500, \$100 and \$50 U.S. Savings Bonds to the three people who collected the most pledges. Dozens of departmental coordinators played key roles in signing up walkers.

Elsewhere:

At **San Diego**, Michael Austin raised \$2,471 and Vernella Furbush collected \$1,513 to lead General Dynamics' contingent. As at Fort Worth, many other employees volunteered to staff the event, including representatives of the San Diego divisions' National Management Associations.

The 60-member team from **Electric Boat** raised the single largest amount, more than \$9,000, in the 12.4-mile Eastern Connecticut WalkAmerica in New London. Sherry Biro, a first-class electronics mechanic, led the Electric Boat group with \$700 in pledges.

Pomona and **Valley Systems** each entered teams in the 12.5-mile event that ran from Rancho Cucamonga through Ontario to Upland, Calif. Pomona's 68 walkers raised about \$6,000 and the Pomona ConTrib Club contributed \$1,000. Seventy-five participants from Valley Systems collected \$4,000.

San Diego-based Space Systems was also represented by employees at **Cape Canaveral** Air Force Station, Fla., and **Vandenberg** Air Force Base, Calif. Vandenberg employees participated for the first time, and their 56-person group raised \$3,000. Eugene Bowen led the way with \$240. Space Systems' Cape Canaveral workers tripled the amount raised in 1989 to \$1,291. Lola Bailey paced the 18-person Cape group with \$424.



Convair's Doug Steudler (left) greets Electronics' John King at the finish line of the San Diego WalkAmerica. Both ran the 15.5-mile course.

DAN NASH

GENERAL DYNAMICS World

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Alexandria slides off the launch ways.

LEO BLANCHETTE

Grunt work triggers sub on ways

TO THE CHEERS of 16,000 onlookers, Electric Boat Division launched on June 23 the embodiment of some of the most advanced technology in the world, the *Alexandria* (SSN 757), the division's 27th 688-class fast-attack submarine.

Toward the other end of the technology spectrum, though, is the launch process itself. The techniques date to the days of the seafaring Phoenicians.

Beginning about 13 weeks before launch day, division carpenters build the launch cradle, the assembly that supports the boat before the launch and provides the ride into the Thames River. The cradle consists of the ground ways, which remain stationary, and the slider, the section that carries the submarine the length of the ground ways and into the water.

About 3,600 pounds of wax and an equal amount of grease are applied to both the slider and the ground ways. The slider and ways are kept apart by 62 grease irons, pieces of metal inserted along both sides of the launch cradle.

According to Jim Lajoie, superintendent of carpenters who was overseeing his last launch before retiring, the operation is basically a matter of transferring the submarine's weight to the launch cradle from the 126

wooden keel blocks that support the hull during construction.

Lajoie had an additional responsibility — for his last launch, he was the triggerman, whose duty is to disengage the final mechanism holding the submarine.

The first phase took place in the afternoon before the launch when a crew of carpenters removed the grease irons — a step that lowered the top of the launch cradle by about half an inch and brought the two sections of the cradle into contact. The half-inch slack was taken up by driving wooden wedges into the assembly and tightening the chains connecting the two sides.

At 5:08 the next morning, the real grunt work began — the transfer of 5,400 tons of submarine to the launch cradle using little more than muscle power. In two-minute bursts of exertion referred to as rallies, teams of carpenters rammed the wedges further into the launch cradle, relieving the pressure on the keel jacks. After 17 of these rallies, the weight had shifted sufficiently to let the carpenters remove the keel jacks under the submarine.

Working in cramped and darkened quarters directly beneath the submarine, 32 men waited for the signal, (Continued on page 2)

Lajoie's last act launches *Alexandria*

JIM LAJOIE knows launches.

The superintendent of carpenters at Electric Boat Division for 21 years, Lajoie has participated in the launching of 67 submarines, including the division's last diesel-powered boat and the world's first nuclear-powered submarine, the *Nautilus*.

Lajoie, who retired this month, joined the division in 1953 as a third-class carpenter and worked his way up to superintendent — the top carpenter — in 1969. As superintendent, he has had complete responsibility for 36 launches, including his last, the *Alexandria*.

The last may well have been Lajoie's best — in addition to overseeing the launch operation, he also pulled the trigger, sending the fast-attack submarine into the Thames River. Typically, the triggerman is chosen from outstanding employees retiring around the time of the launch.

"It's a real honor for me," he said. Despite the fact that he's been involved in dozens of launches, the thrill has not gone. "Every one is important," he said.

That's not to say some launches aren't more interesting than others. Once, the sponsor failed to crack the bottle against the boat, which slid away just the same.

Lajoie, however, had already covered his bases by assigning a former baseball pitcher to keep an eye on things, with an extra bottle of champagne ready. When the sponsor swung and failed to connect, the pitcher wound up and threw, sending his bottle smashing against the submarine. Not exactly by the book, but a christening nonetheless.

■ Dan Barrett

News Briefs

Thirty F-111 bombers move to fighter role at new Western home

Thirty General Dynamics FB-111A bombers recently began moving from Pease Air Force Base, N.H., to a new home with a tactical fighter wing at Cannon Air Force Base, N.M.

The aircraft, built at Fort Worth Division, will be redesignated F-111Gs. They will continue to use advanced avionics, including a terrain-following navigation system, in their new role as fighters.

Pease will be closed to save money, but the aircraft transfer was announced in 1988 before base closure plans were formed. The move is part of an Air Force restructuring and will allow consolidation of F-111 training assets at Cannon.

o o o

YWCA salutes four women

Four representatives of the San Diego divisions have received the YWCA Tribute to Women and Industry award. They are Diane Blankenburg, supervisor-computer system engineering at Data Systems-Western Center; Mary Kay Goodwin, quality assurance program manager at Convair; Barbara Oliver, chief-information resource management voice and data services at Space Systems; and Catherine Toney, manager-quality assurance software at Electronics.

The program honors women who have contributed greatly to their companies.

o o o

Rainy riders raise money

A dozen Material Service Corp. employees and family members braved a downpour to complete an 8.9-mile course in the American Cancer Society's recent bike-athon near Chicago. Material Service pledged \$750 to the group.

Participating employees were Steve Benda, Ann Picciariello, Bob Schovanic, Gail Marzall, Doug Brousil, Kathy Hoekstra, Ed Wilverding and Peter Stamos.

o o o

GD people

Richard F. Hoglund has been named staff vice president-Undersea Warfare Center. He replaces **Gerald Cann**, who was appointed assistant secretary of the Navy for research, development and acquisition. Hoglund had been executive vice president of Areté Associates, which analyzes submarine warfare for the Navy. ...

Nine Valley Systems Division employees have completed a secretary enhancement program: **Jennie D. Acosta, Mary Jo Calmelat, Valerie A. Lundy, Ruby Ludwig, Adelina Padilla, Sue Schumann, Sue Stout, Faye Wolfe and Deborah Woods**. Valley Systems began the program when a survey revealed there was little training at the division in clerical and secretarial work.

o o o

EB-built *Miami* joins fleet

The Navy added a new attack submarine to the fleet when it commissioned the USS *Miami* (SSN 755) June 30. Ceremonies were held at the U.S. Naval Submarine Base in Groton, Conn.

Miami is the 26th Los Angeles-class submarine built by Electric Boat Division. The 360-foot-long, 6,900-ton vessel is the fifth improved SSN 688-class submarine, featuring a new BSY-1 combat system, retractable bow planes, and hardened sail to break through ice.

Current & Comment

Folks out in the suburbs are no doubt pleased with the Supreme Court's latest determination. Come September, when all those leaves start falling, they'll finally be able to deal with them legally. Just rake up a larger-than-usual pile, throw an American flag over the top and light a match. Surely the High Court would not fault the addition of some leafy combustible material to get a good Old Glory-ous blaze going. All perfectly within the law and who can argue?

Who indeed?

Well, maybe there are a few who might take exception. You know the kind. Every year about this time they straggle in a small, ragged line through the subdivision with their kids, disrupting traffic and all dressed up like Nathan Hale or some other historical has-been. The kids have been up half the night draping their bikes with red, white and blue crepe paper and sticking flags in the handlebars. And there's always somebody in a pinched and faded Uncle Sam costume with a wisp of cotton hanging off his chin. And a scratchy, off-key record blaring something loud and brassy by John Philip Sousa. There ought to be a law.

Come to think about it, there are probably more than a few who might object. Out where I live, in rural Missouri River country, it's clear that most folks wouldn't look kindly on anyone torching the Stars and Stripes in the interest of cleaning up his yard — or for any other reason. I hold this opinion as the result of conversations with the locals at the barbershop and at Flag Day ceremonies down on the riverfront. And it is regularly reinforced by rather precisely phrased bumper stickers on many of the pickup trucks around town. It's fair to say that in these parts, at least, legal scholars and others would have some difficulty defending the court's majority opinion that last year's Federal Flag Protection Act was flawed and guilty of "suppressing expression."

But wait. This is America 1990, 214 years after independence and everyone is entitled to have an opinion, even the Supreme Court. So what are Justice William J. Brennan and the four other majority justices REALLY saying in their 1,450-word (less footnotes) opinion? Namely, this: The flag is only a "physical manifestation" of a symbol of the nation and of certain national ideals, and its destruction doesn't really affect the symbol itself. What's more, anyone who burns an American flag is, after all, only communicating, only expressing an idea. And that "communicative value" is protected under the First Amendment.

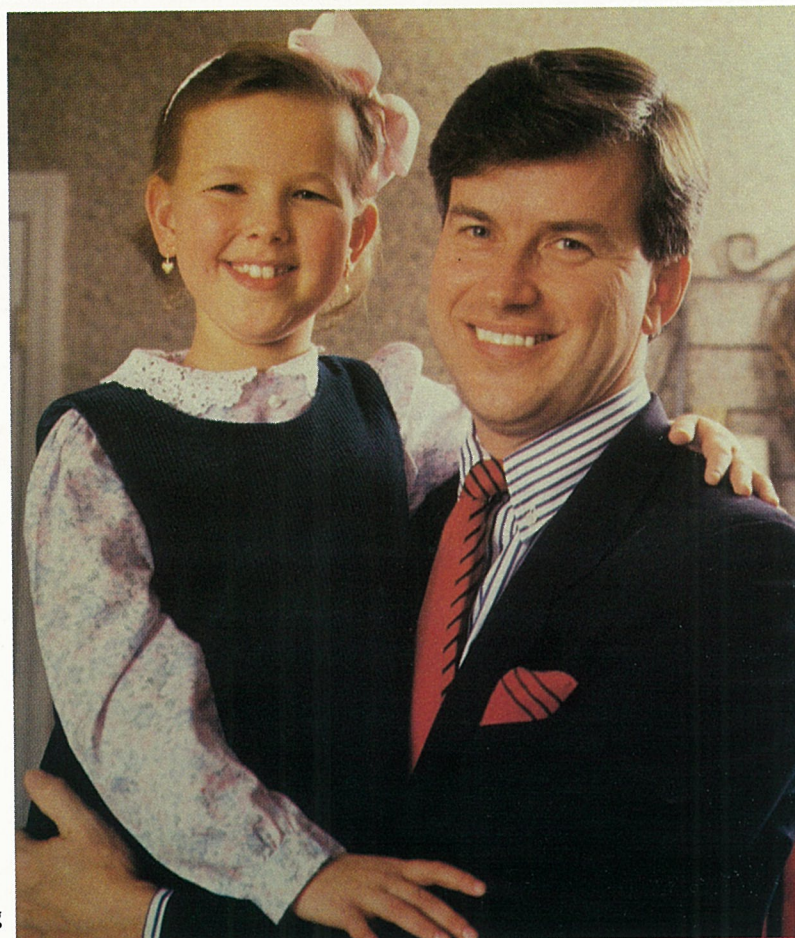
OK. There's some logic to that. At least to the second part of it. We all value and want to protect our right to express an idea. But as the Supreme Court's other four dissenting justices pointed out, that right is not absolute (quote: "...the communicative value of a well-placed bomb in the Capitol does not entitle it to the protection of the First Amendment"). And doesn't the flag have some rather special symbolic value? Isn't there something back there that picks up the pulse a bit when the bleacher fans sing "The Star-Spangled Banner?" Or when hundreds of handicapped Special Olympians stand crookedly at attention for an opening flag-raising? Does that count?

Now that a fix by constitutional amendment has failed, there are murmurings that candidates for high political office will be pressured to show their own colors. That's tough on the candidates, but not an unreasonable expectation for voters. It's too bad legislation didn't give the flag the protection it deserves. What's worse is that it ever had to become a court issue. It would be much more comforting to think that at least one national value remains that could transcend scrutiny by the unblinking judicial eye. ■ **Peter K. Connolly**

*"Ending a major disease . . .
so no other people
have to die from it is
more significant than
anything I can imagine."*

— Ed Ewing

Erin and Ed Ewing



TOM RULE

GD leads fight to lick leukemia

The National Leukemia Society didn't search long for a new leader. Its organizers simply turned to Ed Ewing and General Dynamics.

Ewing, who has been committed to finding a cure for leukemia since his daughter Erin contracted the disease, served last year as the St. Louis chairman of the society's annual televent. The General Dynamics corporate vice president-operations put in tireless hours preparing for the program with considerable company assistance. The result was nearly \$300,000 raised — approximately three times more than the year before.

This year, Ewing has been appointed national chairman of the Leukemia Society's fourth annual televent Aug. 4-5. Others at General Dynamics are again helping.

"We've received tremendous support from (Chairman and Chief Executive Officer) Stan Pace and all the corporate executives," Ewing said. "Not only are they helping to raise money, but they are taking a leadership role."

Pace will appear on the national event. Several division general managers are involved in their regions. Electric Boat Division's James Turner Jr. and Land Systems' Robert Truxell are campaigning in their areas.

The national televent will originate from Paramount Studios in Hollywood, Calif., and will include Hollywood celebrities, leukemia patients, corporate sponsors and volunteers. The 50-station broadcast will be partially sponsored each hour by General Dynamics.

The disease has touched the lives of many General Dynamics employees besides Ewing. Truxell's mother-in-law has leukemia. So does the 28-year-old son of John Scheibel, division vice president-material acquisition at Valley Systems. Relatives of several other employees have died from leukemia.

Scheibel, who was named to the Los Angeles Chapter Board of Trustees for the Leukemia Society, will serve as area chairman of the televent. He has involved other General Dynamics employees.

"Others whose children are afflicted also have agreed to help," said Scheibel, whose son is in remission. "The generosity of our employees, not only in terms of money but also in time donated, has been outstanding."

Charles "Chip" Marquardt, Land Systems vice president-special projects, is working with Truxell to set up a Detroit fund-raising network.

"The Leukemia Society doesn't quite have the networking as some of the other organizations fighting specific diseases," Marquardt said. "Our intent is to raise money and solicit support from the Big Three automakers in Detroit. We want to build a structure for annual support for the Leukemia Society."

San Diego's technological community is the target for Paul Bokros, division vice president-operations at Electronics. He has the support of his counterparts at Convair, Ken Lake, and at Space Systems, Ed Squires, as well as Data Systems-Western Center's Mike Beebe, manager-business systems development.

Ewing, meanwhile, has set several goals for his chairmanship.

"My objective is to double last year's national total of \$5.1 million and increase that figure until we raise \$20 million in 1992," he said. "I believe if research funds are provided, the decade of the 1990s will be the final decade of our battle against leukemia."

Last year, General Dynamics provided a \$25,000 donation plus volunteers who answered telephones. That helped St. Louis vault from 18th nationally in fund-raising the previous year to first overall. This year, General Dynamics has committed \$50,000.

"I'd like to use the successful methods we used in St. Louis last year and build that into an infrastructure for the other 49 states," Ewing said.

Only a decade ago, 15 percent of leukemia victims were treated to the point where they could expect a normal lifespan, according to Ewing. Today, he said, the outlook is 85 percent remission for those 18 and younger.

"Leukemia can be treated effectively today," he said, citing his daughter's remission of the disease. "But we want to wipe out leukemia altogether."

"I am proud to have the opportunity to finish the work so many have started. To be on a team that ended a major disease and retires it so no other people have to die from it is more significant than anything I can imagine."

■ **Myron Holtzman**

Launch

(Continued from page 1)

then swung their sledgehammers in unison, knocking out four jacks each and shifting the weight completely to the launch cradle.

At that point, all that secured the *Alexandria* were two jacks known as dog shores, and the trigger, a mechanism with a pair of two metal arms that hold the slider in place. The dog shores were removed at 9:55 a.m., giving Lajoie a few moments for reflection before getting the go signal and activating the trigger.

Out of his view, at ceremonies at the other end of the submarine, the sponsor, Mrs. Myrtle C. "Tookie" Clark, ascended the steps to the launch platform to christen the *Alexandria*, prompting Lajoie to assume his place at the trigger.

A roar of approval erupted from the workers on the ways, who later directed a round of applause Lajoie's way. "That finishes it for real," said Lajoie, grinning. "That's the way to end a career."

■ **Dan Barrett**

Small firm poised to make big waves with minisubs

Big things are happening at one of General Dynamics' smallest independently operated units.

Applied Remote Technology, Inc., a San Diego-based, 60-employee company acquired by General Dynamics in March 1989, is developing systems that promise to send large ripples through the murky world of undersea warfare.

The company is working on quiet propulsion systems with General Dynamics' submarine builder, Electric Boat Division. Other projects include underwater communications and sensors. But Applied Remote Technology is known best as the country's leading small firm in autonomous underwater vehicles.

These vehicles are miniature robot submarines. The size and shape of a torpedo, they can be programmed to do a number of tasks and can be launched by a conventional sub. "Autonomous" means they operate independently, unlike other unmanned vehicles that are "driven" by signals sent over a tether connecting the vehicle with the mother ship.

"Enemy subs are getting quieter and hence more difficult to detect, so we need to extend the battle area of our submarines," said John Shilling, director-programs for General Dynamics' Undersea Warfare Center. "An unmanned vehicle can carry acoustic sensors out and report back. Or it could go ahead of the sub and map a path through a minefield. The next generation of subs will surely have this capability, and we could even backfit this capability into some current sub classes."

Exploring that sort of futuristic idea is one of the roles of the Undersea Warfare Center, a 28-person unit opened by General Dynamics in December 1987 in Washington, D.C. The center identifies promising concepts and customer requirements and matches them with technologies being developed by General Dynamics' divisions.

Applied Remote Technology fits perfectly into the center's mission. The company was founded six years ago by three underwater vehicle experts who left a large firm and went on their own. Applied Remote Technology had already built two autonomous underwater vehicles when the Undersea Warfare Center got involved. The center determined that starting an underwater vehicle subsidiary was too expensive, and Applied Remote Technology was the only small company that had constructed and operated such vehicles.

General Dynamics proved to be the ideal partner for Applied Remote Technology, too. "To continue to grow, we had to align ourselves with a big defense company," said Ron Walrod, the company's president and one of its founders. "GD has good, solid, long-term interest in undersea warfare. The other positive is that GD has a strong presence in San Diego with facilities and resources that it could bring to bear."

Walrod's company has eagerly accepted General Dynamics' aid. Employees on loan from the San Diego divisions are helping Applied Remote Technology meet the peak staff needs of its growing business. The firm has moved some of its operations into Convair Division buildings on the waterfront near the San Diego airport. General Dynamics' capital funded a recently completed barge, pier and access ramp on San Diego Bay behind the Convair facility.

The barge houses the XP-21, which is a company-built autonomous underwater vehicle. The 16-foot, 21-inch-diameter vehicle can carry payloads in modules that expand its length up to 24 feet. Its range is 30 nautical miles, it can dive 2,000 feet and can travel up to 5 knots.

The XP-21 has performed a number of experiments, including laying several miles of fiber optic cable on the sea floor for American Telephone & Telegraph Co. The vehicle will soon begin one of its most important missions, an underwater liaison with a manned submarine. "This is the first step toward our ultimate



Some of the staff at Applied Remote Technology pose with the XP-21 (clockwise from left): Gerald Schnieder, Jim Deveau, John Engel, Joe Drammissi, John Guerre, Bill Garmer and Steve Thompson.

objective of an unmanned autonomous vehicle working closely with a manned sub," said Steve Thompson, a program manager for Applied Remote Technology.

A research submarine, USS *Dolphin*, will work with the XP-21 at a depth of 200 feet. One objective is for *Dolphin* to control the XP-21 with signals sent to surface engineers who will relay commands to the vehicle. Another is to demonstrate that manned and unmanned subs can operate safely together under water.

"These vehicles are still very developmental," Walrod said. "The big challenges are to carry enough energy for power, giving the vehicle enough intelligence to do the job, and making the control system reliable."

Still, the day isn't far off when a first-line Navy submarine will have an autonomous underwater vehicle aboard. Applied Remote Technology's Walrod predicts that will occur in five to 10 years. When that happens, it's quite possible the vehicle will be a work of ART.

■ Dave Lange

Undersea technology not a fish out of water

Applied Remote Technology reports to Undersea Warfare Center Staff Vice President Dick Hoglund, but remains almost as autonomous as its unmanned vehicles. It has continued as an independent small firm since General Dynamics acquired it. The Undersea Warfare Center provides management oversight, research and development funding, and analysis of the potential applications of unmanned underwater vehicles.

Although a largely independent operation, the San Diego firm wants to work closely with other parts of General Dynamics in sharing technology. It would seem that its work on underwater systems would limit Applied Remote Technology to combined efforts with undersea warfare operations such as those at Electric Boat Division. But there is much to share with many General Dynamics affiliates.

In fact, "we haven't found a division or activity at GD where there's not an application of our technology," said Ron Walrod, president of Applied Remote Technology. "For example, Land Systems is working on robotic land vehicles that have the same communication, control and technical problems as our autonomous unmanned vehicles. Valley Systems is involved with warheads, electro-optic scanners and miniaturization.

"We are an integrating company: We take computers, manipulators and sensors, and integrate them to perform a mission. We integrate diverse technologies from throughout GD."

Walrod's company offers other General Dynamics divisions a wealth of experience in the diverse technologies that go into underwater sensors, scanners, vehicles and communications. His staff has worked on dozens of underwater systems, including autonomous and tethered unmanned vehicles as well as manned submersibles. The company has developed and built six Adjustable Diversity Acoustic Telemetry Systems for underwater communications. The firm has also researched and developed advanced laser undersea sensors.

Speed, cost and location are other advantages. "We can do things faster, as good and cheaper than the competition," Walrod said. "We can design vehicles, put them in the water and test them, and we can operate year-round because of the weather here."

These attributes have not been lost on external customers. Before its acquisition by General Dynamics, Applied Remote Technology built a 30-foot underwater vehicle for Martin Marietta Corp. Applied Remote Technology recently completed a project for American Telephone & Telegraph Co. and won major work as a subcontractor to Westinghouse Electric Corp.

"We predicted that we'd start to see a positive return on our investment in ART in 1995 or '96," said John Shilling, director-programs at the Undersea Warfare Center, the General Dynamics unit that acquired the company. "But we are forecasting that to occur much sooner."

■ Dave Lange

GENERAL DYNAMICS

World

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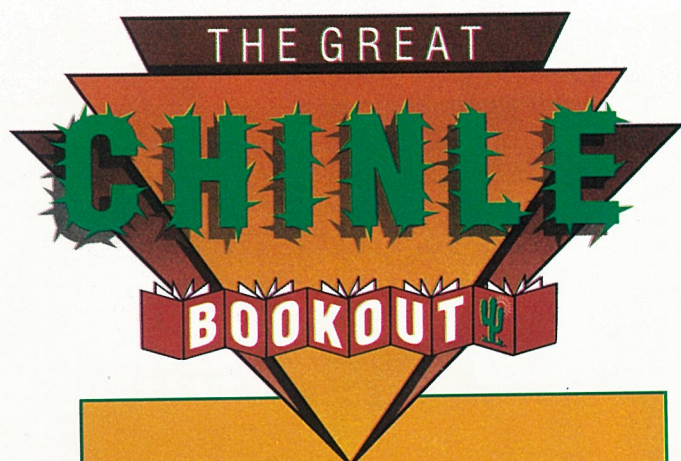
Engineer shows his class at Cal Poly-Pomona

Mike Klaassen, a Valley Systems Division quality engineer, was chosen valedictorian at recent graduation ceremonies of the California Polytechnic University-Pomona School of Engineering.

A school committee selected Klaassen because of his high grades in his graduating class of 657. He received a bachelor of science degree in electrical engineering with a computer option. He was named to the National Dean's List and was appointed a President's Council Scholar because of his high academic rating.

Klaassen, who learned of Valley Systems' need for engineers at a Cal Poly-Pomona career fair, joined the division in September 1989 and was recently promoted. He evaluates software for the missile homing improvement program.

Klaassen received an associate of arts degree in business administration from Long Beach City College before attending Cal Poly-Pomona. He received scholarships to Long Beach and Cal Poly-Pomona.



Nestled in northeast Arizona, tucked in the heart of the Navajo Indian Reservation, lies Canyon de Chelly. Red clay cliffs rim its valleys, creating a breathtaking panorama that only nature can provide.

Minutes away, in stark contrast, lies the tiny community of Chinle. A drought that has lasted several years, together with strong winds and hot afternoon sun, have left the town dry and barren of most vegetation. Approximately 4,000 Navajos live there. An estimated 72 percent are unemployed, nearly twice the reservation's average. Small decaying homes and trailers emphasize the area's economic problems.

Entertainment means going shopping, renting a movie, and stopping by Taco Bell, townspeople say. The tiny community library that provided another source of recreation was padlocked eight years ago because of a fund shortage. After vandals broke in, the books were transferred elsewhere. Several attempts to revive the local facility faltered for lack of money.

Thoughts of another library seemed destined to remain a dream — until General Dynamics stepped in.

Booked up

Employees send 30,000 volumes to start

GEORGE SALAMON, corporate manager-editorial services, visited Chinle two years ago to write a story for *Together*, General Dynamics' community relations brochure. He described how 19 students in Chinle Junior High School's Advanced Learning Lab had taken an educational trip to Florida's Kennedy Space Center and Epcot Center thanks to a \$17,000 donation from General Dynamics.

Salamon was startled by conditions in Chinle. "When I did the story, I felt very strongly about the kids there," Salamon said. "You couldn't help but be touched. When I was told there wasn't even a library, I felt surely our company, with 100,000 employees, could donate enough books to start one."

Chairman and Chief Executive Officer Stan Pace approved Salamon's idea. General Dynamics' employees at the Corporate Office and the six Data Systems Division locations in St. Louis, Fort Worth, San Diego, Pomona, Calif., Norwich, Conn., and Temecula, Calif., agreed to collect, box and ship the books.

The campaign, christened "The Great Chinle Book-out," began late last year.

BOXES of books from General Dynamics arrived in Chinle for months. The storage space and hallways of the federally funded Projects Building of the Community School District were bulging. More than 370 crates have been delivered. More continue to trickle in.

"There were so many boxes, the fire marshal even cited us," said Beth Witt, the assistant director of the school's federally funded education program. "That didn't bother us, though. We were just thrilled the crates kept coming."

The crates contained approximately 30,000 volumes, including novels, textbooks, children's books, magazine collections and several sets of encyclopedia. The employees' generosity will help establish the new Chinle Community Library and Family Literacy Center for the Navajo community.

Two classrooms at the old Chinle Elementary School have been cleared to house the library. Residents have held almost weekly "parties" to unpack, sort and put the books on shelves. The library is scheduled to be fully functional this summer.

"Everything is beginning to happen so fast here," Witt said. "Now, it seems, the whole community is getting caught up." Some examples:

- Several school employees have volunteered to catalog the books and coordinate the staff.
- The school's federally funded programs have combined to finance a full-time librarian.
- Clay Sneed, the food services director for the schools,

told his supervisor of the library project and obtained a \$500 donation from ARA Food Services for the operating budget.

- The Navajo book project in Gamarco, N.M., about 90 miles from Chinle, said it would donate 100 new books each month to the library.

"I just feel like I'm on a sled going downhill," Witt said. "The whole idea is snowballing. When the books started coming in, other things began to happen."

Sneed agreed. "Every time you talk to someone, something else is happening for the library," he said.

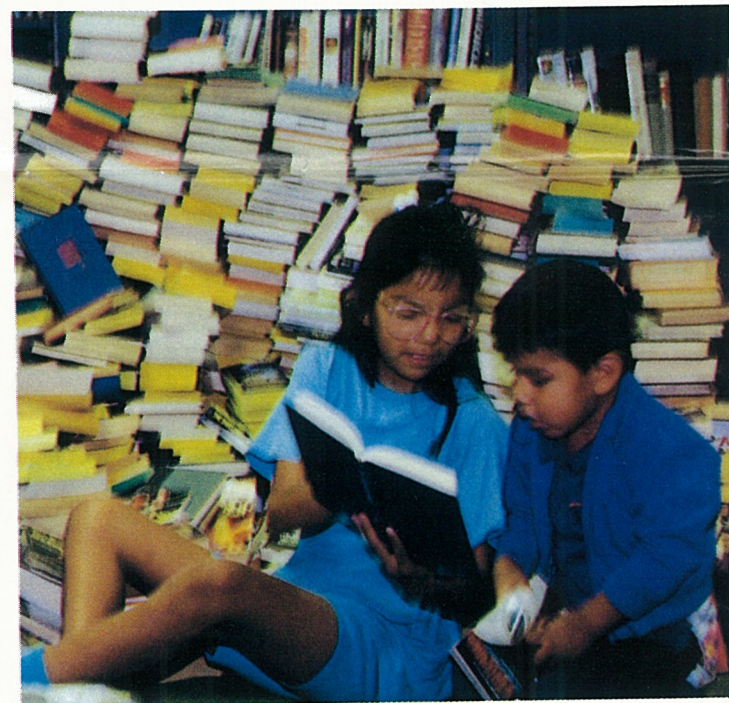
The youngsters are the biggest winners of the project, said Dean Jackson, superintendent of Chinle United School District 24. "Illiteracy rates run high in the area and that's why people don't read for pleasure anymore," he said. "This library will generate that interest again. This is a dream come true for these people. It's an important step."

BOBBI TENEQUER likes to reflect on the times her older sister took her to the old Chinle Community Library for the Saturday morning story hours.

"I enjoyed those times," said Tenequer, now a freshman at Chinle High School. "I used to go to the library a lot to read and enjoy myself. I learned a lot just reading. It was fun."

Tenequer was one of the 19 students who took the General Dynamics-sponsored trip to Florida. By making that trip, she is a part of the library's revival, she says.

"Being part of that makes me feel good," she said. "I



MYRON HOLTZMAN

Churches, schools chip in for Chinle

North Kingstown High School has a unique relationship with General Dynamics' Quonset Point Facility in North Kingstown, R.I.

"They help us by sending us guest instructors and some other assistance," said Paul Rennick, the school's principal. "We wanted to do something in return for the company."

The school's administration, as well as the North Kingstown Chamber of Commerce, learned of "The Great Chinle Bookout" through Quonset Point. The school collected texts through a book drive. About 40 boxes of books went to Chinle.

"We felt that since General Dynamics sort of adopted us, why don't we adopt this project and adopt Chinle High School as well," said Lizann Gibson, the director of the business/education partnership for the North Kingstown Chamber of Commerce. "The kids were excited about the book drive. I feel we're teaching them volunteerism and that's something we seem to be losing sight of in our American society."

The school is planning ways to establish other relationships with the high school. "We've talked to our

student council," Rennick said. "There are the possibilities of exchanging correspondence and yearbooks — and possibly student exchanges. We have two completely different environments with a common factor — education. The possibilities are many."

Added Gibson: "We want to make this an ongoing concept. This has brought the town, the business community and school community together."

Meanwhile, the San Diego Friends of the Library, a non-profit organization that raises money for San Diego County libraries by selling books, heard about the book drive from a retired GD employee who is also one of their volunteers. They collected and shipped 1,500 books to Chinle.

O'Fallon Tech High School in St. Louis learned of the project from Robert Cotton, a student who is a part-time General Dynamics employee. The school donated some textbooks. Wyse Advertising, which handles General Dynamics' corporate advertising, also contributed. Various organizations and church groups near General Dynamics facilities heard of Chinle's plight and held their own book drives. ■ Myron Holtzman

remember the pleasure I use to get from the library and now other kids are going to have the chance I had. I feel, in a way, like I've helped them."

Colleen Davis, another student who made the trip, is hoping the literacy rate will rise sharply as the new library is established. "Many of the people here are uneducated," she said. "Some parents now will be able to take their kids to the library to study and perhaps read themselves. Wouldn't that be nice?"

Added Liquori Nez, another freshman at Chinle High: "I hope this is going to be a really good library. I went to Gallup, N.M., several times and the library made the trip worth it."

AS AN English teacher at Chinle Junior High School, Sylvia Barlow can appreciate what the library will mean to her pupils.

"The original trip was taken to broaden their horizons," said Barlow, who accompanied the students to Florida. "Most of these kids spend their lives here and don't know what it's like outside the reservation."

"Now, the whole community is thrilled at what is

happening with the community library."

"The library is a great thing. We recognize it now."

as a reminder of our library center."

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Left: stack

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GENERAL DYNAMICS!"

start Navajo library

happening. They understand we're trying to promote community literacy. We want to get the parents involved with the kids and the library is a great beginning."

"The Great Chinle Bookout" has given the community renewed hope, Barlow and Witt said.

"When you have the school district's support, you recognize that you have a viable program going," Witt said. "We have the leaders of the community with us now. We're planning adult education programs as well as renewing Saturday morning story hours. We'd like our library to have the feeling of a big-city literacy center."

Added Barlow: "The kids are thrilled that General Dynamics cared enough about them that they didn't just give them money for a trip and forget about them. That's made an impact on them."

Dorrea Walker, who taught at Chinle two years ago and approached General Dynamics for a contribution for the Florida trip, said it was a special gesture that General Dynamics wanted to help start a library. "But to tell the truth, I really didn't think anything would happen," she said.

Last year, Walker moved to Prescott, Ariz., where she is a high school teacher. She said she lost track of the library project and was delighted to hear that her initial letter for help produced a special response from General Dynamics.

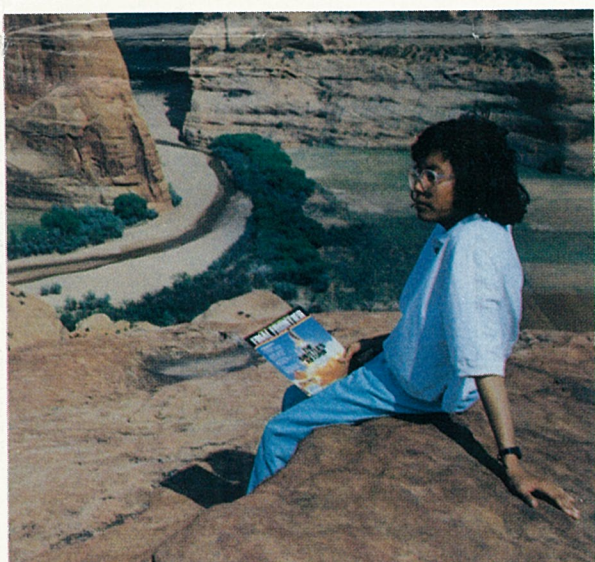
"From what I hear, the whole community is involved up there," she said. "I'm just so happy for the kids."

■ Myron Holtzman

Left: Janicia Curley and her brother, Raynel, examine a stack of books sent to Chinle.

Below: Audrey Emerson, one of the Chinle students who traveled to Florida, sits high above Canyon de Chelly.

Bottom: Boxes full of books are loaded in St. Louis for shipment to Chinle.



TOM RULE



JACK NOBLE

Jesse Martinez enters information with a Shop Floor Control System terminal at his work station in numerical control machining.

Fort Worth's Shop Floor Control System shoots down division's paper airplanes

It's an old saying in the aerospace industry that the paperwork required to build an airplane weighs as much as the final product.

Fort Worth Division's manufacturing development department tackled the truth behind this maxim while developing the Factory of the Future, a concept for a modernized, integrated production facility.

Manufacturing systems engineers designed a computerized Shop Floor Control System to replace the numerous paper shop order packages that accompany an aircraft part on its months-long journey through the factory.

The system recently achieved what is believed to be an industry first: The numerical control machining area manufactured a production aircraft part without the paper shop order package.

The project took another big step in May when printing of paper shop order packages ceased for the F-16 plant's entire numerical control machine shop and first-cut metal preparation area. About 130 Shop Floor Control System terminals handle the numerical control machining and first-cut paperless operations.

"Using the system is really not a big change for the production employees," said Lee McNulty, project manager for Factory of the Future. "Users touch a screen to access or add information instead of using the paper shop order package."

"The big returns are in the system's flexibility to respond to changes, in cutting down the waiting time traditionally associated with accumulating tools and other resources to prepare jobs for manufacturing, and in selecting the best job to work next."

Four groups of employees use the Shop Floor Control System: manufacturing operators, inspectors, production control expeditors and supervisors. The system is available 24 hours a day.

Users log on to the system with their employee badges. The system reads the user's employee number from the magnetic stripe on the badge, determines what type of user the person is, and displays all the information the person requires.

Operators use the touch screen to request the system to select the next job to work, continue with a job that

is already in work, or allow the supervisor to select the next job. The system provides the operator with data that includes discrepancies during production of the same part number, up-to-date manufacturing work instructions, and visual aids. The system requires the operator to enter information formerly recorded on the paper shop order package.

Inspectors use the system similarly to the operators and also enter inspection-specific information.

The system identifies the tools and other resources needed to do the job. Expeditors use this information to gather resources before they are needed and to move parts through work areas on time.

The Shop Floor Control System provides supervisors with information about finished jobs and allows them to record acceptance of completed work. Supervisors can also assign employees to work stations and establish job selection criteria, using the insight provided by the system's forecasting abilities.

"It's really an evolutionary system, continually improving," said system project engineer Ned Harrison. "And a lot of the improvements are the result of ideas from the users."

The system was initially developed as part of the Advanced Machining System contract jointly funded by General Dynamics and the Air Force. The company funded the initial implementation and is continuing to fund additional development, enhancement and implementations.

Shop Floor Control System use in the new composites manufacturing center is a must because of the expected high volume of orders with complex and lengthy manufacturing instructions for the next-generation Advanced Tactical Fighter and A-12 aircraft. "It would be practically impossible to manage and control those shop orders in a paper shop order environment, merely due to the number of operations required to make composite parts for the A-12 and ATF," said Ken Watson, project manager for the composites manufacturing center systems.

The system will be progressively expanded to serve all of Fort Worth's fabrication areas with more than 2,000 terminals, McNulty said.

■ Joe Stout

TQM

CASE STUDIES

More teamwork cuts F-16 rework at Fort Worth

The six members of Fort Worth Division's Nonconformance Reduction Team have become familiar faces in a large area of the F-16 assembly line.

At first, supervisors and workers viewed team members as just somebody else to peer over their shoulders.

There was uneasiness that the team would point fingers at recurring discrepancies, called Quality Assurance Reports, on work done in Dept. 146 assembly areas for the F-16 aft fuselage, vertical fin and horizontal stabilizer.

Concerns diminished when team members began talking to people who actually do the job and know why things do or don't work.

Hopes were raised that the team might even be helpful when it gathered and combined information from the different functions involved in a process to devise solutions.

The idea seemed so simple. Yet no one had tried it.

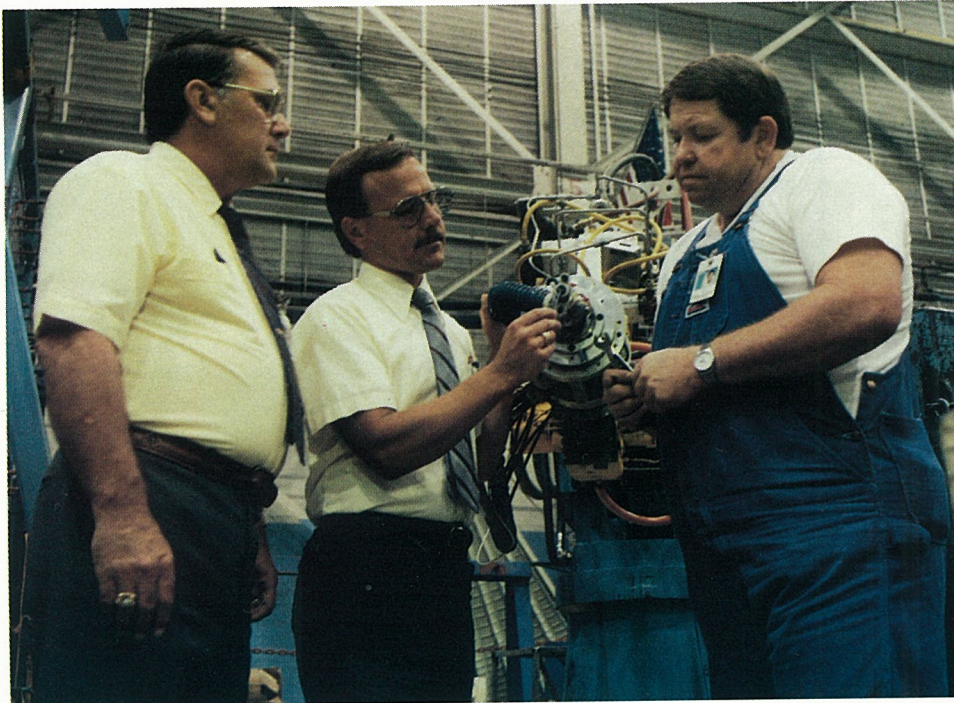
The team proved its value during the three-month pilot project in Dept. 146 that began in March:

- The team has proposed 17 solutions to 27 repetitive or critical production problems.
- Quality Assurance Reports declined from 270 in March to 249 in April to 212 in May, while the number of work units processed remained steady.
- The time to plan corrections for recurring problems has been reduced.

The team concept has expanded to other production areas. At least 10 additional teams are planned or already working.

A division-level Corrective Action Critical Process Team for manufacturing originally proposed the team concept. That team is one of 23 created to implement total quality management at Fort Worth.

Members of the pilot Nonconformance Reduction Team are coordinator Tim Almaroad, a corrective action specialist; Greg Isaac, quality control; Richard Davidson, tooling and planning; Joe Avery, manufac-



Richard Davidson (left) and Joe Avery (center) of the Nonconformance Reduction Team join robot operator J.B. Nabors in checking an end-effector of a horizontal stabilizer drilling robot.

turing operations; Bob Taylor, manufacturing engineering; and Jeff Wyatt, research and design engineering.

The members work full time on the team and coordinate their activities with Dept. 146 and F-16 assembly management. The team represents different departments and functions to apply a broad knowledge.

When a Quality Assurance Report needs the team's attention, the problem is documented and assigned a priority. The root cause is determined and solutions are proposed. "But we don't decide on our own how to fix things," Almaroad said. "We go out and tie in resources, which is the main benefit of being a cross-functional team. We collectively have access to a lot of different resources."

The team's approach to a problem with robotically drilled holes in the F-16 horizontal stabilizer assembly is a good example that the concept works. Elongated holes and similar discrepancies added up to about a

33-percent rejection rate. Each unit required an average of 4.07 hours of rework, resulting in schedule delays and increased costs. At least one entire unit was scrapped just before the team began work.

"We talked with the people from the shop floor, the quality department, tool services, the robotics laboratory and other functions," Almaroad said. "It looked like a workmanship issue, but the team determined that many of the hole anomalies were actually caused by a maintenance problem with the robot end-effectors, which hold the drill bits, and with the bits themselves."

"We required that a maintenance schedule be developed for the end-effectors and bits, and that the design of the tooling template be modified to ensure that the bit is always guided to the right place."

The team also found ways to increase tool availability and improve facilities. The rejection rate has declined to less than 5 percent.

The central link in the team's success has been improved communication, according to Avery. "After they saw a few results, people realized that they have a place to go with their ideas," he said. "We found that some people had helpful information but didn't know what to do with it."

Dept. 146 Quality Assurance Supervisor Bill Davis explained: "We've always interfaced... but we evidently failed to communicate. The team approach results in quick turnarounds for our problems."

Davidson said communication improved as the same team members were seen in the work areas week after week. "The more we help the supervisors and people on the floor, the better response we get from them," he said. "Continuous communication seems to promote continuous quality improvement."

■ Joe Stout

Space Systems probes hard-to-make rocket parts

The hardest part to make for Space Systems Division's Atlas booster and Centaur upper stage? Actually there are 77 of them, but the division's hard-to-make-parts Process Action Team intends to shrink that list to zero.

They have started with No. 1 on the list — a cylindrical piece of hardware called a probe. Probes, which come in seven different variations, measure propellant levels in the Atlas and Centaur tanks. They are basically large, exotic gas gauges measuring from 2 to 15 feet long.

At first glance, the probes might not look especially complicated, but rigorous welding requirements and detailed assembly processes account for the difficulty in making them and the negative effect on the production schedule. The team has been studying the seven probes since March to identify problems and improve the manufacturing process.

A study of the quality history on all probes since 1988 showed that welding caused most of the problems.

"Our best fix to date has been to get rid of two difficult-to-weld parts with stringent X-ray requirements by designing single machined mechanical parts," says Team Leader Bob Hamilton, project engineer, Titan/Centaur program office. "The old process was taking 3½ months and we forecast the new process will take three weeks."

Other changes included reducing an X-ray weld inspection requirement to dye penetrant inspection, resequencing manufacturing processes to make all probes consistent in assembly, and a design change to increase the thickness of a welded part — all of which will alleviate problems in welding defects.

"Our best fix to date has been to get rid of two difficult-to-weld parts... by designing single machined mechanical parts. The old process was taking 3½ months and we forecast the new process will take three weeks."

— Bob Hamilton

Hamilton credits formal total quality management training with giving the team the tools to operate effectively.

"Formal training was invaluable," says Hamilton. "I feel strongly that the strict meeting format we learned has been beneficial to the effectiveness of the group. With rotating roles, everyone has ownership of the process. Another benefit has been active participation by the TQM people. They are full members of the team and have helped to keep the team on track."

The team meets once a week for two hours. The team sets its agenda for each subsequent meeting and assigns the time to be spent on each agenda item. One team member takes minutes and another keeps an eye on the clock. Each session ends with a critique of the meeting.

In addition to serving as Process Action Team leader, Hamilton also leads a "tiger team" to speed assembly of specific probes and relieve the factory logjam. Thus he is a focal point in coordinating the activities of both groups by making sure each group shares its data.

"The Process Action Team is not time-oriented like the tiger team," Hamilton says. "The PAT works on processes that would best turn around the fabrication span times. We ask what we can do with those processes by looking at inspection points, planning sequences, handling and manufacturing flow. If we fix the processes, we will not only fix the probes but other parts as well."

Hamilton's Process Action Team members are Marga Fritze, total quality management division facilitator; Hans Frazier, avionics engineer; Jack Koon, structural engineer; Therese Tawoda, industrial engineer; Phil Baker, producibility engineer; Mike Gusha, quality assurance; Gary Weaver, production control; and Janet Watson, division total quality management coordinator.

The team has completed its short-term plan for probes and is working on a long-term action plan. In about a month the team will move on to the next hard-to-make part.

Space Systems operates more than 30 Process Action Teams. The division will soon make available a shared file on the electronic mail/office system that will contain information on the Process Action and tiger teams.

■ Julie Andrews



Dale Coleno displays his F-16 in the loading area of Freeman United's surface mine in Industry, Ill.

Four years and more than \$1,000 later, Freeman employee completes flyable F-16

When Dale Coleno was a kid, he had an uncle who flew as a navigator in Air Force B-47 Stratojets. When uncle visited, he'd let Dale wear his flight helmet.

"I wanted to be like him," Dale said.

Dale is. At work, he is responsible for all the electrical operations of the Freeman United Coal Mining Co.'s surface mine in Industry, Ill. At other times, he "flies" a General Dynamics F-16 Fighting Falcon.

But Coleno doesn't wear a g-suit and helmet as his uncle did. Dale's F-16 is a 1/8-scale model that he built. His flying equipment is a radio he operates from the ground to control his F-16.

Actually, the F-16 hasn't been airborne yet. First flight is scheduled this summer. Coleno, who has built and flown six other radio-controlled aircraft, is understandably nervous about sending up his F-16 after investing nearly four years and over \$1,000 assembling and detailing the plane.

"I just can't bear to see it crash," he said.

Coleno constructed the F-16 from a kit that his wife, Gail, gave him for Christmas in 1986. He's detailed the plane to look like the first F-16 built, in the paint scheme it wore at the 1975 Paris Air Show. The 11-pound model needs 100 feet of pavement for takeoff and landing, has retractable landing gear and features operating

control surfaces. The 74-inch-long fuselage is made of fiberglass and the wings and tail surfaces are styrofoam. The engine powers a ducted fan that propels the F-16 over 100 mph. A fuel mixture of nitromethane, synthetic castor oil and alcohol keeps the aircraft aloft up to 15 minutes.

More than 1,000 of the F-16 kits have been sold, Coleno said. "However, there's more built than are flown," he said. "People would rather look at them than break them."

Coleno flies with other members of the Canton Hilltop Radio Control Flyers off the club's blacktop strip in Canton, Ill., where Coleno lives. Raising a family—he has 20-year-old twins, Lisa and Maria—has cut back on the 40-year-old Coleno's air time. He still manages to fly his other models about three times a month.

It will be a courageous undertaking when he tries his F-16. Mishaps with radio-controlled models are common.

But Coleno has a contingency plan. His model can be modified to an F-16XL, which features a larger, cranked arrow wing. "That's probably what I'll do if I crunch it," he said.

■ Dave Lange

Regional awards show GD's support of small business

Convair and Land Systems divisions recently showed that support of small and small disadvantaged business is an integral part of General Dynamics' corporate procurement policy by winning regional awards as prime contractors of the year from the U.S. Small Business Administration.

General Dynamics' corporatewide program was established some 25 years ago, well in advance of the congressional laws that required small and small disadvantaged business plans. The value of the company's contract awards to small and small disadvantaged firms has increased almost annually.

General Dynamics is a corporate dues member of the National Minority Supplier Development Council in addition to other local and regional councils and associations. The company is represented at more than 100 conferences and trade fairs each year in support of small and small disadvantaged business.

"Our program has key management support from (Chairman and Chief Executive Officer) Stan Pace on down," said John Huebener, corporate purchasing manager. Monty Dickinson, staff vice president-material, is designated the focal point for the General Dynamics' small and small disadvantaged business program.

The success of that program shows at Convair and Land Systems. Convair has documented over 100 cases of assistance to small and small disadvantaged business, which exceeded the requirements of its contracts.

The division arranged special presentations, held in-plant conferences, and provided financial, technical and quality assistance to small firms, according to Lorise W. Maynard, Convair's small business administrator. In 1989, Convair awarded over \$111 million to small business, including more than \$16.5 million, or 4.7 percent of its total commitments, to small disadvantaged business.

Examples of Convair's small business dealings include:

- Aircraft Engineering, a small disadvantaged business, was awarded a \$3.6 million contract.
- Cherokee Nation, an American Indian firm, received purchase orders from Convair totaling over \$50,500.
- G.W. Bandy, a small disadvantaged firm, contracted to supply hinges for the MD-11 fuselage under a \$2.3 million, five-year contract.

Land Systems, meanwhile, "makes the maximum effort to give each known potential small business and small disadvantaged business concern an opportunity to compete," according to its policy. In 1989, Land Systems awarded more than \$185 million, or 49.9 percent of total purchases, to small business and almost \$14 million, or 3.7 percent, to small disadvantaged business. The percentage to small disadvantaged business has risen from 2.1 percent in 1987.

Highlights of Land Systems' 1989 program were:

- 81 new small disadvantaged suppliers, up from six new suppliers in 1988.
- Holding a supplier fair in West Virginia to introduce Land Systems to the small business community.

"It's a tough program that we've outlined for ourselves and we're working hard to adhere to that program," said Mel Ryan, material compliance chief at Land Systems.

■ Myron Holtzman



TQM togetherness. Representatives from throughout General Dynamics who train employees in total quality management examine materials from each other's programs during a recent meeting at the Corporate Office. Twenty-three trainers met to discuss their programs and how they could share resources to keep their programs viable with a reduced budget. Attendees included (from left) Ken Gowen, Space Systems Division; Allen Cote, Electric Boat; Doug Gammage, Land Systems; Cindy Henson, Electronics; Ron Hollister, Data Systems-Central Center; Kari Jones, Fort Worth; Bernie Landau, General Dynamics Services Co.; Phil Paul (wearing glasses), Data Systems-Headquarters; Gene Hepler, Space Systems; and Roberta Baade, Corporate Office.

Savings and stock investment plans

	Annual rate of return for the 12-month period ending:		
	May 1988	May 1989	May 1990
Salaried			
Government bonds	7.5%	8.1%	8.3%
Diversified portfolio	(7.5)%	29.9%	15.8%
Fixed income	11.0%	10.5%	10.2%
Hourly			
Government bonds	7.7%	8.3%	8.3%
Diversified portfolio	(7.7)%	30.5%	15.9%
Fixed income	11.0%	10.5%	10.2%
GD stock closing price	\$54.12	\$57.37	\$35.50
() Denotes negative number.			

Convair's twin-engine oldies go on forever; so do parts and service

TWO gentlemen from Ensenada, Mexico, showed up at Convair Division's Lindbergh Field gate last year carrying an oily piece of hose in a brown bag. They were looking for a replacement part for their Convair 580 twin-engine aircraft.

These aircraft are not consigned to the history book just yet, and the Aircraft Logistic Support group was able to help the two men, even though such support usually does not take the form of over-the-counter sales. Nor does

to carry passengers. European Air Transport operates the high-time Convair aircraft, a 580 with almost 80,000 hours and 136,000 cycles.

"Convair was historically the Cadillac of airplanes," said Bob Baldwin, senior service engineer in the group. "The airplane just refuses to quit." And when it does get into

supplemental inspection document at the administration's request that consists of a list of known areas that should be inspected based on the engineering group's historical data.

Convair is also working on an aging aircraft program in conjunction with the FAA. Convair is reviewing all service bulletins to determine which should be made mandatory. There are surprisingly few, according to Baldwin, considering the age of the airplanes. Convair will submit the report to the FAA by the end of the year, along with a corrosion document also being prepared.

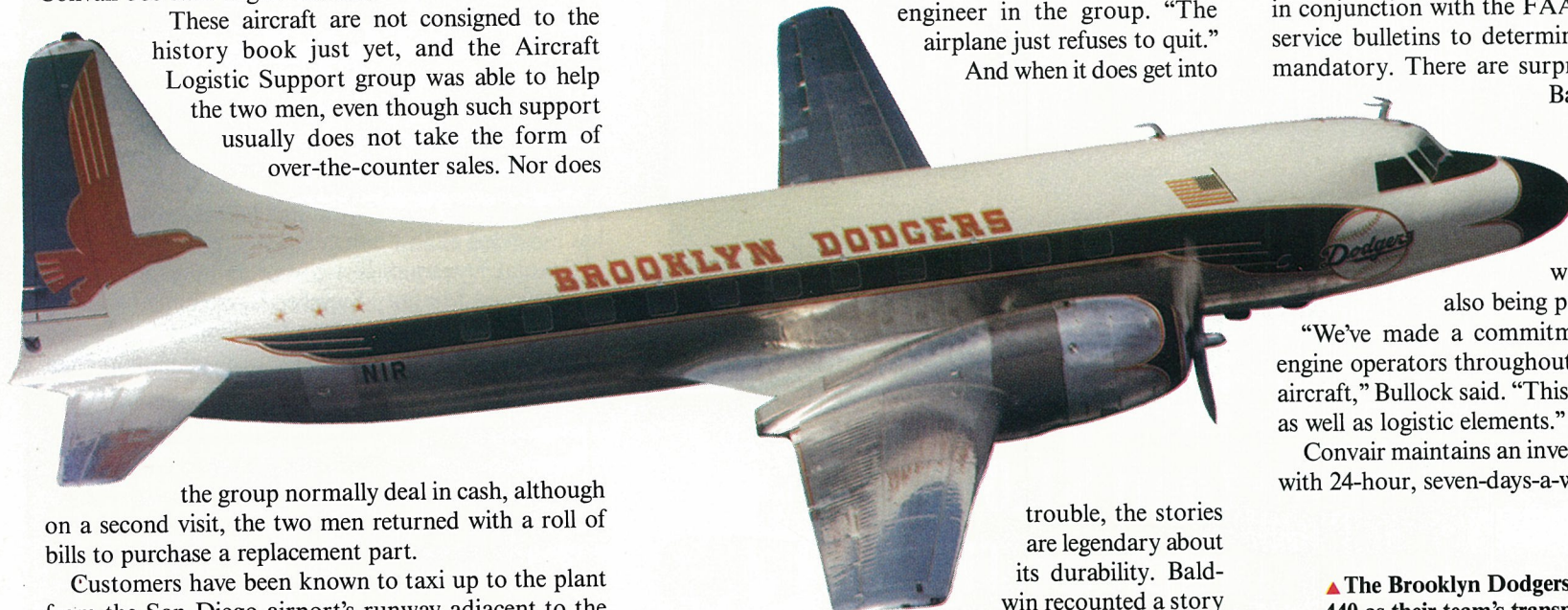
"We've made a commitment to support the twin-engine operators throughout the operational life of the aircraft," Bullock said. "This support includes technical as well as logistic elements."

Convair maintains an inventory of about 5,000 spares with 24-hour, seven-days-a-week service.

■ Julie Andrews

▲ The Brooklyn Dodgers used a Convair Model 440 as their team's transportation.

▼ A Convair aircraft is rebuilt into a stretch Model 580 by Kelowna Flightcraft.



the group normally deal in cash, although on a second visit, the two men returned with a roll of bills to purchase a replacement part.

Customers have been known to taxi up to the plant from the San Diego airport's runway adjacent to the Lindbergh Field facility, according to Bill Bullock, logistics chief. Bullock directs the group in providing spares and service engineering for the approximately 350 Convair twin-engine aircraft still operating around the world.

"We chair an operators' meeting every other year," Bullock said. "This year 145 people attended. There were 44 operators and 26 suppliers, including all the suppliers of the original equipment for the aircraft. They have indicated they will supply spare parts through the year 2000 for the twin-engine program."

The twin-engine aircraft consist of the models 240, 340, 440, 600, 640 and the Allison-modified 340/440, called the 580. They were made in the 1940s and '50s. Most were modified to turboprops in the '60s. The aircraft are used primarily as cargo carriers.

A company called Kelowna Flightcraft is developing a stretch 580, which will lengthen the aircraft about 14 feet by incorporating two plugs. Kelowna proposes to convert 50 aircraft to the stretch version for cargo transport. Company representatives displayed a model of the stretch 580 at this year's operators' conference. One airline — Aspen Airways — is still using the 580

trouble, the stories are legendary about its durability. Baldwin recounted a story about a 580 that hit a very high TV antenna in North Dakota square on the propeller shaft. The 580 knocked over the antenna but landed safely.

Another time a 340 hit a tree on final approach. Part of the tree imbedded itself in the leading edge of the wing. The plane continued to land safely. The president of the airline had the piece of tree mounted and displayed in his office.

If the airplanes go on forever, the service engineers in the product support group will be doing what they're doing now — developing Federal Aviation Administration-required or requested documentation to help the operators maintain air-worthy planes. For example, Convair has come up with a



Pomona just WSILs to design, test new weapons

The capability of computers to take people to the "what-if" realm has given Pomona Division engineers a new set of tools to more accurately design and test sophisticated weapons.

It all takes place in the state-of-the-art Weapon System Integration Laboratory or WSIL (pronounced whistle). The lab's computers support a wide range of engineering functions, including concept development, field evaluation, battlefield management studies, and real-time, hardware-in-the-loop simulations. The 10,000-square-foot facility in the middle of Pomona's engineering building houses computer stations, central processing, war game rooms, a system integration area and a management briefing room.

According to Yung-Koh Yin, the lab's principal architect and manager, the lab's computers help engineers develop and test new weapons using simulation at all stages of the process.

"In the design stages, we can test guidance and control software algorithms and embedded codes," Yin said. "The lab also has the capability to validate the software's operational flight performance."

The lab's engineering analysis area allows design engineers to perform aerodynamics, propulsion, stress, thermal and control system analysis on new weapons as they are designed.

"Using data from these analyses, we can predict such things as rocket motor performance, dispersion patterns of debris, thermal stresses on a missile in

flight, missile separation from aircraft, and bottom-line performance measures such as miss distance and probability of target damage," Yin said. "Before WSIL, this information might only have been obtained through extensive and costly testing."

Operations research and war gaming help determine the effectiveness of conceptual or existing weapons in a potential tactical situation. One program, the Model of the Outer Air Battle II, developed by engineering specialist Chao Lee, is a two-sided, force-on-force simulation. It is used to develop and evaluate tactics, particularly in electronic warfare.

Lee also led the development of the newest derivative, the Interactive Weapon System Simulation. This war game models air platforms, surface assets, air-to-air weapons, sensors and battle management. It allows for realistic situation-oriented inputs from "commanders" initiating or reacting to several levels of combat.

In a typical "engagement," tactics between friendly and threat aircraft include radar detection, infrared search and track, target selection, weapon assignment and cooperative engagement tactics for friendly aircraft.

Although much of the lab's simulation is done through computers, the Aircraft Interface station has been receiving much attention because it is dedicated to development of the division's Advanced Air-to-Air Missile, Yin said. The station includes an avionics and

weapons management model simulating the F-14 Tomcat's weapons system as well as the controls and displays to employ the system. It also has various elements of Advanced Air-to-Air Missile equipment.

"Using the aircrew station, we can develop and test component software with actual hardware and simulate tactical performance as part of the integrated weapon system," said Dick Polly, Advanced Air-to-Air Missile integration engineer.

The capability to bring test or tactical hardware into a lab to verify software and hardware designs and aircrew interfaces, without having to use customer assets, is necessary for cost competitiveness, Polly said. The facility also has a static F-14 aircraft, located in its own building nearby, which is used to develop and test various physical interfaces between the weapon and aircraft.

"We designed it to be cost-effective and capable of expansion as technology and requirements may dictate," Yin said. He explained that by keeping current with state-of-the-art developments, the lab has the capability to evaluate some of the newest technology such as close-in, directed-energy weapon systems.

For all its capability, the real purpose of the lab is to keep the division competitive, Yin said. "WSIL is just one more tool to help us be more responsive to our customer," Yin said. "If we accomplish that, it will have served its purpose."

■ Eric Solander

Valley Systems, Pomona to merge

The company made the following announcement as General Dynamics World went to press.

The Valley Systems and Pomona divisions will consolidate into a single business unit called the Air Defense Systems Division, General Dynamics announced Aug. 6.

"The consolidation, effective immediately, is the result of declining business prospects in the defense industry," said Ralph Hawes, executive vice president-missiles and electronics.

The expected result of consolidation activities and the erosion of the business base at the former Pomona and Valley Systems divisions will be layoffs of 1,500 to 2,000 employees through the end of 1991, Hawes said. More than 600 of the layoffs will be caused by the elimination of duplicate jobs as the divisions are combined.

Michael C. Keel has been named corporate vice president and general manager of the new division. He had been corporate vice president and general manager of Valley Systems since January 1988. Sterling Starr, who had been corporate vice president and general manager of Pomona, will assist in the initial steps of the consolidation pending reassignment.

All changes resulting from the consolidation should be defined by the end of the year and should be completely implemented by the end of 1991, Hawes said.

"While we all welcomed a diminished threat from the Soviet Union and the end of the Cold War, these changes have brought unfortunate personal economic consequences for many people in the U.S. defense industry," said Keel. "We very much regret that layoffs will be necessary, and we will try to cushion the impact by providing professional career consulting and placement assistance services to affected employees."

Pomona Division, located in Pomona, Calif., is approximately 16 miles west of Valley Systems, which is in Rancho Cucamonga, Calif. Pomona produces Standard and Sparrow missiles and Phalanx shipboard air defense systems. Valley Systems builds Stinger and Rolling Airframe missiles.

"In order to remain competitive in a declining market for missiles and other air defense systems, General Dynamics must more efficiently use its existing resources and reduce overhead," Keel said. "Between our Pomona and Rancho Cucamonga sites, we will have more capacity than is required to meet our future needs. However, we have not yet made any firm decisions to relocate any production lines."

The Pomona Division began in 1952. Valley Systems was formed out of Pomona in 1985 in response to the then expanding military market. The new Air Defense Systems Division will not only operate facilities in Pomona and Rancho Cucamonga, but also in New Mexico, Arizona, Arkansas and San Diego County.

Last call for photo entries

Only one month remains to enter the General Dynamics employee photo contest. Entries must be received by Friday, Sept. 14.

Any 8x10 color or black-and-white photo taken by an employee since June 1, 1989, may be submitted. Each employee may submit only one entry. Company photographers are not eligible.

Twelve winners and 36 runners-up will be selected and will be published in a 1991 calendar similar to the one inserted in this issue. Each winner will receive a \$200 U.S. Savings Bond. Each runner-up will be given a \$100 bond.

Include full name, division, home address and home and work telephone numbers with each entry. Also send a description of the photo — where and when taken, and with what equipment — along with a self-addressed, unstamped envelope and cardboard stiffener. Negatives must be available upon request and no darkroom effects are allowed.

Send entries to Contest, Public Affairs Office, General Dynamics Corp., Pierre Laclède Center, St. Louis, MO 63105. More information is available by calling (314) 889-8564.

Company ad — pages 4 and 5

GENERAL DYNAMICS

World

Volume 20 Number 8

August 1990

Quarterly loss is \$240 million

The second-largest write-off in its history resulted in General Dynamics taking a \$240 million loss during the second quarter.

The company reported a special pretax charge of \$500 million against earnings. The charge represented \$450 million of estimated cost overruns in the Navy's A-12 aircraft program and \$50 million of estimated cost overruns on the Army's Single Channel Ground and Airborne Radio System. The company's only previous write-off larger than that taken for the A-12 was a \$464 million charge on the purchase of Cessna Aircraft Co.

Without the special charge, second-quarter net earnings were \$90 million on sales of \$2.6 billion.

General Dynamics and McDonnell Douglas Corp. are teammates in the A-12 program, a full-scale development and initial production contract for the Navy's new carrier-based Advanced Tactical Aircraft. General Dynamics and McDonnell Douglas share profits and losses equally. The two companies are less than halfway through full-scale development, while somewhat more than half of the ceiling price has been spent or committed.

(Continued on page 2)

Atlas mission launches company into commercial space business

General Dynamics blasted off into the commercial space business on July 25 when an Atlas I lifted a research satellite into orbit from Cape Canaveral Air Force Station, Fla.

The mission marked the company's first launch of a commercial Atlas. The vehicle is the first of 60 Atlases General Dynamics is building for commercial and military use. A team of General Dynamics employees conducted the launch while NASA maintained direct oversight.

"With this launch, General Dynamics joins the ranks of space-age pioneers in the exciting new era of commercial space transportation," Secretary of Transportation Samuel K. Skinner wrote in a congratulatory letter to the company.

The Atlas booster and its Centaur upper stage carried the Combined Release and Radiation Effects Satellite. It will study the interaction of the ionosphere and magnetosphere and the effects of space radiation on microelectronic components. The spacecraft, part of a joint Air Force-NASA mission, will travel in a highly elliptical orbit of 218 by 21,000 miles.

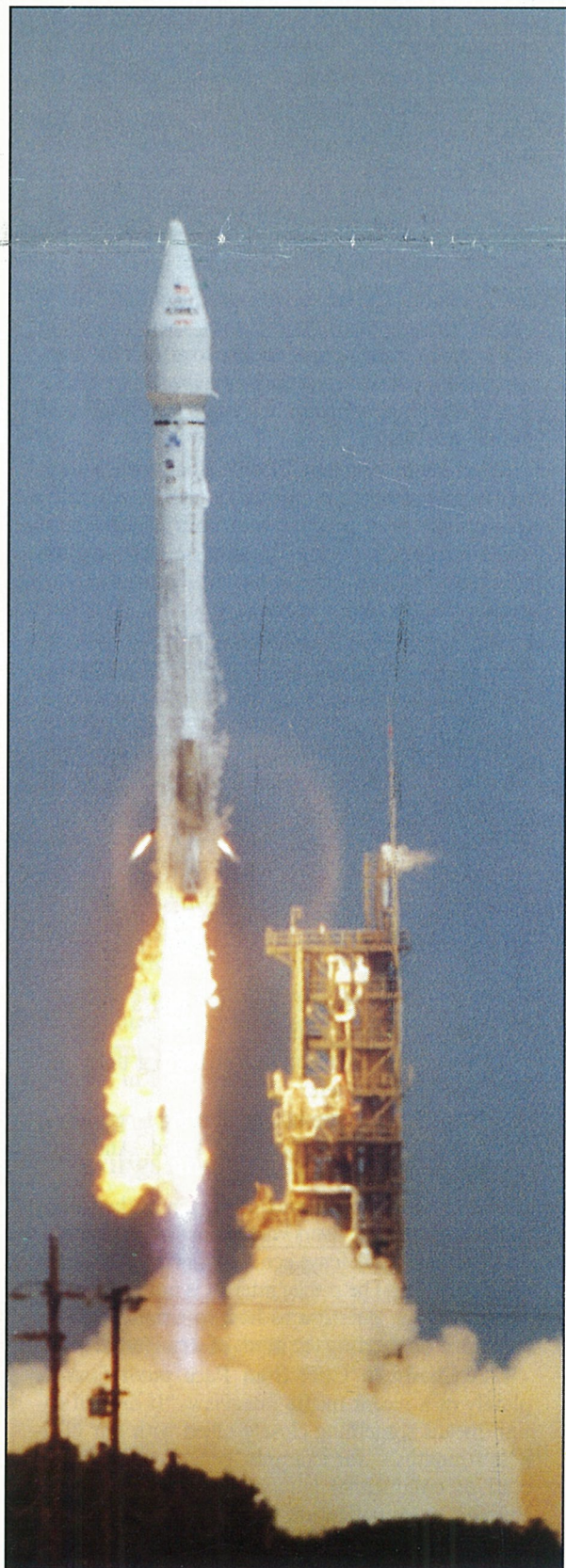
"Preliminary data indicates that the spacecraft is operating as planned," said Bill Swords, satellite project manager at the Marshall Space Flight Center in Huntsville, Ala. "We have been activating the spacecraft experiments and will continue to activate them and check out the spacecraft for the next 30 days."

NASA Deputy Administrator James R. Thompson called the launch "an important step forward in the 'new way' in which NASA is doing business with the private sector for expendable launch vehicle services."

General Dynamics expects to support anticipated launch requirements through 1998 with Atlas production and launch rates of eight per year. General Dynamics Commercial Launch Services has orders for 23 commercial Atlas launches. Its customers, in addition to NASA, include the European Telecommunications Satellite Organization, the International Telecommunications Satellite Organization, Hughes and British Aerospace. Atlas will also launch 10 military missions in the Air Force's Medium Launch Vehicle II program.

Atlas is being marketed to domestic and international customers in four versions and is capable of addressing about 90 percent of the expected launch market through the 1990s. Besides the Atlas I used for the July 25 launch, the Atlas family includes Atlas II, a model under development for the Medium Launch Vehicle program; Atlas IIA, which is similar to Atlas II but with an uprated Centaur propulsion system; and Atlas IIS, which is outfitted with four Castor IVA solid rocket motors and capable of placing payloads of up to 7,700 pounds into orbit.

The Atlas I is a derivative of the Atlas/Centaur built by Space Systems Division for NASA.



The Atlas I lifts off its pad at Cape Canaveral.

DAN NASH

Current & Comment

Now that Soviet Bloc members have seen the light, a new candidate for redemption has been identified.

The U.S. defense industry.

Ours, however, is to be a purely economic, non-ideological conversion. Come what may, say the sideliners, it's time to beat swords into steak knives and roofing shingles. Each day, new and louder voices join the clamor to transform weapons makers into "productive" outlets of popular consumer goods. Elected and non-elected officials alike lead the crusade. They're supported by evangelizing editorials and encouraging words from every public figure in North America—with the possible exception of Ivan Boesky and Oil Can Boyd.

In Washington and in state capital offices, the topic of economic conversion is high on the agenda. A 10-senator conversion task force is busy studying how defense companies might be forced to set up "non-defense alternative" planning offices. State governors and House members, meanwhile, are meeting behind closed doors to consider proposed conversion legislation, some of which would fall just short of jailing contractors who fail to come up with "alternative use" plans. One Midwestern governor comments that the industry will be challenged in "meeting the civilian sector's tougher delivery standards." An op-ed piece suggests that aircraft engine manufacturers, for instance, study local landfills with an eye to producing powerplants fueled by garbage-generated bio-gas. Another likely product, it reasons, would be energy-efficient prefabricated housing.

All of this makes for lively and imaginative discussions among those who labor in the defense industry vineyards. How, for instance, might GD's divisions rally to the challenge of replacing out-of-fashion combat systems with products that have a greater mass appeal? As it stands, there is little in GD's current defense product line to attract the average citizen-consumer (except maybe Stinger as a top-of-the-line addition to your Neighborhood Watch inventory).

What about returning Electric Boat, for instance, to the pleasure boat business? (Its speedy Elco motorboats were popular with both Coast Guard and rumrunners during Prohibition.) Or research submersibles? (EB built more and better minisubs during the '60s than anyone in the world.) Nuclear-powered submarine tankers, maybe? That, too was tried by EB—30 years ago. A noble but unrewarding effort.

Given global warming threats, perhaps a venture into home and industrial air conditioning units? Convair's reputation of many years would give it an immediate market awareness. ("When It Comes To Cool, There's No Air Like Convair.")

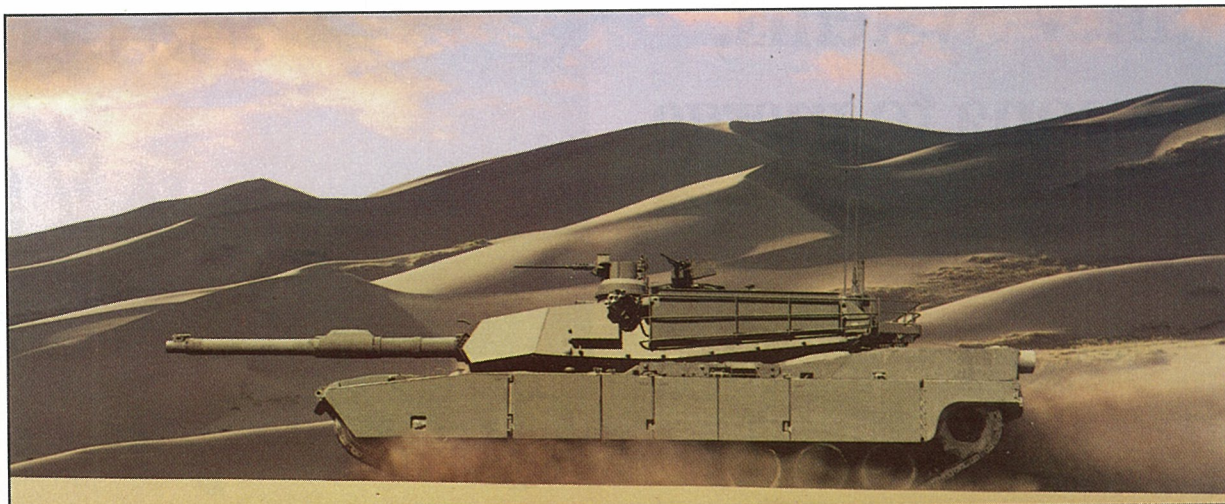
None of this tongue-in-cheek posturing is to suggest that defense companies lack either the resources or the willingness to search out reasonable substitutes for their fast-shrinking markets. The fact of the matter is that:

- 1) Ours is a specialist industry and a dramatically different culture.
- 2) We're not aware of any promising untapped markets out there.
- 3) It's simply a case of not wanting to go where man has gone before. And failed. And gone again—and failed. And...

Murray Weidenbaum, ex-chairman of the Council of Economic Advisors who is now writing a book on the changing defense economy, gets to the heart of the matter: "The public interest is not well-served by viewing the question as how to employ defense companies in meeting the needs of a civilian society."

GD Chairman/CEO Stan Pace put it just as plainly in a recent media interview: "If diversification means something closely allied with our business strengths—for example, general aviation aircraft or commercial launch vehicles—that's fine. But that's diversification in part, not in whole; it doesn't mean making Pampers."

■ Peter K. Connolly



The M1A2, shown in a computer-generated simulation of Saudi terrain, is the newest version of the Abrams tank.

Saudi buy brightens Abrams' outlook

Prospects for continued production of Abrams tanks at Land Systems Division received a boost when Saudi Arabia recently signed an agreement with the United States to purchase 315 M1A2 tanks.

The tanks are scheduled to be delivered from 1993-96, a period when the Department of Defense had proposed suspending production for U.S. forces.

Saudi Arabia will buy completed tanks instead of coproducing or assembling them. The sale will generate approximately \$1.8 billion of direct and indirect income to the United States and about 57,000 man-years of work. The United States will also derive economic benefits from the sale of ammunition, lifetime spare parts and tools, training support and auxiliary equipment.

Other benefits include \$108 million in research and development recoupments and rental fees to the U.S. government and \$413 million in gross tax revenues for national, state and local governments. Lower unit costs made possible by Saudi tank production will help save \$135 million for the U.S. Army in manufacturing its tanks.

"This is a particularly important transaction," said Robert W. Truxell, Land Systems general manager. "At a time of declining U.S. requirements, international sales will play a key role in our efforts to maintain a warm M1A2 production base during the 1990s."

■ Donald L. Gilleland

Quarterly Report

(Continued from page 1)

General Dynamics' charge to earnings includes reversal of the \$24 million in earnings previously recorded on the A-12 and 50 percent of the company's present estimate of the team's anticipated cost in excess of 1) the \$4.8 billion ceiling of full-scale development and 2) the fixed price of the first initial production lot. Costs have increased because of a delay in the program caused by requirements for more complex tooling to make large structural composites.

"Despite these charges, I would like to emphasize that there are no 'technical showstoppers' in the A-12 program," Chairman and Chief Executive Officer Stanley C. Pace said. "The industry team has designed an outstanding aircraft, which is significantly superior to the aircraft it replaces and which will meet the Navy's operating requirements and needs."

General Dynamics and McDonnell Douglas anticipate filing a claim with the Navy later this year to recover some costs.

The \$50 million write-off for the Single Channel Ground and Airborne Radio System is the result of design changes and higher-than-anticipated material

costs. General Dynamics and its partner, Tadiran of Israel, are basing their radio on one made by Tadiran that required some design modification to meet Army specifications. This redesign was more complex than anticipated. Some vendors have also been asked to prepackage some parts to facilitate General Dynamics' automated production process. As a result, costs of certain components have increased.

On the positive side during the second quarter, Fort Worth Division met its projected recovery schedule for F-16 deliveries and Cessna boosted General Dynamics' general aviation earnings to \$22.6 million from \$9.3 million in the second quarter of 1989.

Dollars in millions, except per-share amounts

	Second quarter		Six months	
	1990	1989	1990	1989
Net sales	\$2,624.4	\$2,529.7	\$5,115.4	\$4,890.6
Net earnings (loss)	\$(240.0)	\$ 58.4	\$(116.3)	\$ 133.8
Net earnings (loss) per share	\$ (5.75)	\$ 1.39	\$ (2.78)	\$ 3.20

A-12 restructuring returns Rogers to FW

General Dynamics has restructured the management of the A-12 Advanced Tactical Aircraft program at Fort Worth Division. One of the changes has sent President and Chief Operating Officer Herbert F. Rogers to Fort Worth with the special assignment of division general manager.

Rogers had been vice president and general manager at Fort Worth from 1981-87.

Charles A. Anderson, corporate vice president and general manager of the Fort Worth Division, has undertaken a special assignment as program director of the A-12. John P. Lamers, vice president of the A-12 program, has become deputy program director.

Vice Chairman William A. Anders will assume Rogers' corporate management responsibilities and reporting relationships. Fort Worth and Material Service Corp. will report directly to Chairman and Chief Executive Officer Stanley C. Pace. The Defense Initiatives Office will report to Dave Wheaton, corporate vice president-program development and planning.

These assignments will bring the necessary corporate and division resources and attention to bear on the critically important A-12 program, according to Pace.

"At the same time, Rogers' special assignment as general manager of the Fort Worth Division will assure that the other important aircraft and business programs of the division receive continued management focus," Pace said.

The management changes resulted from recent difficulties with the A-12 that prompted the company to take a \$450 million loss on the program.

GENERAL DYNAMICS

World

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Pomona linking laid-off employees to job opportunities

Nobody could predict that it was only the beginning when Pomona Division announced a reduction in its work force three years ago to meet the demands of an increasingly competitive environment. But reduced defense budgets and the unforeseen breakup of the Soviet Bloc are causing layoffs throughout the industry.

Pomona's employee force has fallen from more than 9,500 in 1987 to 5,500 today. Pomona's management realized when it planned the reduction that it isn't just a business decision — it affects people. Steps were taken to help employees find another job or even another career. Today the division has a wide range of programs, including direct assistance and liaison with networks throughout the industry and region, that coordinate human resources services to the industry and its workers.

The cornerstone of Pomona's program is the Career Transition Center. The center helps departing employees with their job search. The center is staffed by professionals who are skilled in hiring and knowing what prospective employers look for.

"The career center is a one-stop, full-time service where people can quickly get started in finding other jobs," said Ole Olsen, staffing administrator who oversees the operation. "We have a full range of services, including help in preparing, typing and mailing resumes and letters."

Other services consist of a job bank, job matching with employers who have listed with the division, information on company-sponsored job fairs, and telephones for calling prospective employers. The center also sponsors classroom programs to improve job-hunting and interviewing skills; information on retraining programs available through state job listings; and help in getting answers about benefits, re-employment compensation, and other related matters.

"The center really acts as a clearing house to match workers and jobs," Olsen said. "We even maintain the list of openings here at Pomona and other GD divisions so those opportunities are not missed." There is always some replacement hiring or positions opening on new work in-house, Olsen said.

The career center also is the focal point for seminars put on by state agencies, the UAW-Labor Employment

and Training Corp., and the Employment Training Agency of Western San Bernardino County. These groups retrain employees for other work.

"We're pleased with the progress the center is making because it has been open only for a short time," Olsen said. The center had been organized to coincide with varying layoff cycles. Now, it is open full time.

"Its success can be measured by how well we are directing people to jobs," Olsen said. "For some, the

results have been very successful and very immediate. We've arranged interviews for people who have immediately been given job offers and are working the following week."

The division gives up to 20 hours paid time off to use the center for those laid off. However, the center's hours are such that workers also can use it after or before their regular shift. The center has an entrance outside plant gates for former employees still seeking work.

The division also holds job fairs for present and former employees. The division sent invitations to the most recent fair to more than 500 former employees. About 125 people met with representatives of aerospace, electronic, government and other commercial companies at the fair.

"We understand it is difficult to transfer to another aerospace company since most are undergoing the same downsizing as us," Olsen said. "The job fairs introduce people to a wide variety of opportunities and we welcome anyone who is hiring. Most of those attending felt that it was very worthwhile and beneficial to them. Many people left with possibilities of jobs and interviews."

The division is a charter member of The Aerospace Human Resources Network Office, the first consortium of its kind in the country. The office was organized by General Dynamics, Hughes, Lockheed, McDonnell Douglas, Northrop, Rockwell International and TRW to fill openings in California. It matches jobs with highly skilled displaced workers who otherwise might be lost to the industry.

The office will work with the California Employment Development Department and with company representatives to provide specialized services, including recruitment, a professional network group, job development and referral to training. The program features the state's new "Job Match" computer system, which can quickly match job openings with applicants.

"As we move into a new era, the Aerospace Human Resources Network is building for the future," said Karen Berk, deputy director of the California Employment Development Department. "From a human resources perspective, this joint venture builds a long-term capability that will keep California's aerospace industry strong."

■ Deborah Lamborghini



A recent job fair attracted more than 100 people.

RAM starts run on production line at Valley Systems

Limited-rate production of the Rolling Airframe Missile for the Navy has begun at Valley Systems Division's main plant in Rancho Cucamonga, Calif., and at the division's Navajo Agricultural Products Industry plant near Farmington, N.M.

The Rolling Airframe Missile counters anti-ship missiles. It is the second major program to enter production at Valley Systems. The division also makes the Stinger anti-aircraft weapon.

The Rolling Airframe Missile's work force of about 120 is expected to increase to 250 by the first quarter of 1991.

The program has formed several teams to aid in the production transition, according to Pat Thacker, director-Rolling Airframe Missile production. The teams focus on specific areas and include employees from several disciplines such as engineering, manufacturing, purchasing, manufacturing control and quality assurance.

The leaders and teams are Jim Womack, seeker head; Rick Nelson, microwave; Teri Brantley, circuit card assemblies; Rob Humble, control section; and Dan Kuz, hybrid microelectronics assembly. The teams meet at least once a week, but members work together every day.

The teams will not only build the missiles, but will also evaluate and start using new test equipment.

"We are making maximum utilization of existing hardware to aid in the evaluation of both in-process and final acceptance test equipment to ensure that we will be turning out a quality product at or below contract cost," Thacker said.

All of the necessary production equipment is in place and workers are being hired as needed to meet schedule commitments, which will eventually reach up to 75 missiles per month, said Loyd Torrey, product line director.

Employees in one of the buildings at the main plant in Rancho Cucamonga will provide seeker heads, cryo-



Jon Holler, a production engineer, inspects stripline boards for the Rolling Airframe Missile.

genics assemblies, autopilot instruments and hybrid microelectronics assemblies. Final assembly employees in another building are proofing all the in-process and final acceptance test equipment. The first hardware will be assembled and tested this month.

The division's precision machine shop is providing detailed parts for the seeker head and autopilot instruments. Microwave board details will be manufactured in the division's new microwave lamination facility.

Personnel at the New Mexico facility on the Navajo Reservation are providing circuit card assemblies and round wire harnesses; three more parts are in the later stages of proofing, Torrey said.

Pomona Division employees are providing metal parts and mechanical assemblies. They will also assemble the missile and conduct final tests at a new Valley Systems site in the Highland Industrial Park near Camden, Ark. First deliveries to the customer under an \$85.6 million, 500-round limited-rate production contract are scheduled for late September 1991. Deliveries

will start at five per month and reach 60 per month over 12 months.

Approval for full production is expected later this year if the missile successfully completes Navy operation and evaluation tests. So far, tests have shown high reliability of the missile and the launcher and their effectiveness against single and multiple targets.

After the limited-rate production contract and approval for production, Valley Systems will compete against RAMSYMS GmbH of West Germany for a share of the annual missile production.

The Rolling Airframe Missile launcher is being coproduced by Valley Systems and several West German companies under contract to Translant, Inc., a joint venture between General Dynamics and German industry. Translant received a \$230 million contract for launcher production last October.

Valley Systems Division will fabricate and deliver the launcher interface control assembly and the launcher switching multiplex unit. The launcher will be assembled and tested in Germany.

■ Jerry Littman

Savings and stock investment plans

	Annual rate of return for the 12-month period ending:		
	June 1988	June 1989	June 1990
Salaried			
Government bonds	7.4%	8.5%	8.1%
Diversified portfolio	(6.2)%	21.0%	16.1%
Fixed income	11.0%	10.5%	10.2%
Hourly			
Government bonds	7.7%	8.7%	8.2%
Diversified portfolio	(6.4)%	21.5%	16.3%
Fixed income	10.9%	10.4%	10.2%
GD stock closing price	\$53.00	\$58.25	\$32.00
() Denotes negative number.			

General Dynamics' ethics program marks

Those familiar with General Dynamics' reputation for building aircraft, missiles, submarines and tanks may not know that the company has also designed an excellent listening device.

It's called the ethics program.

Born five years ago this month during a low point in the company's relations with the Navy, the ethics program provides guidelines for daily business conduct. The program features a network of ethics directors, telephone hot lines and a national post office box that employees can use to voice questions or concerns about the meaning or application of the program's guidelines, called the "General Dynamics Standards of Business Ethics and Conduct."

"A lot of people simply want someone to listen to them and give them some advice," said Alda Jorgenson, ethics director at Space Systems Division.

The ethics directors do a lot of listening. They handle about 5,000 inquiries annually. "That indicates a high awareness of the program," said Kent Druyvesteyn, staff vice president-ethics program. "I'd like to meet an employee who could say, 'Ethics program? Never heard of it.' I don't think you could find one."

Druyvesteyn, who was hired in October 1985 to direct the program, says it is supported by three pillars:

I. Guidelines: These are contained in corporate policies and procedures and in "General Dynamics Standards of Business Ethics and Conduct."

Five corporate policies and procedures dealing with ethics have been written since 1985. The Standards are contained in a 20-page pamphlet more popularly known as "the blue book," which is in its second edition and is given to each employee.

"The Standards contained in this booklet are like road signs," Chairman and Chief Executive Officer Stanley C. Pace wrote in the introduction. "They give directions in areas of daily business activity where possible problems of conduct could occur."

II. Communication: Thirty-two division and subsidiary ethics directors and 28 local hot lines form a two-way communications system with employees. They can also call Druyvesteyn on a companywide hot line or write him at a private post office box.

One important trait sought in ethics directors is their skill in dealing with people. "The biggest characteristic you need for this job is patience," said Chuck Stieber, Land Systems ethics director. "When you get a call, you have to listen, sometimes for a long time."

Another major communications effort was to brief each employee on the program in 1986. The ethics program has been included in new-hire orientations since that time. All new employees sign cards attesting they have received and read "the blue book" and understand the Standards are company policy. The cards become part of personnel records.

The program is further publicized through hot line posters displayed at all facilities, distribution of the ethics standards to all employees, stories in division newsletters, and prominent listings in plant phone directories and employee handbooks.

Ethics directors, hot line numbers

(* = hot line numbers)

CORPORATEWIDE		ELECTRONICS	
St. Louis—Kent Druyvesteyn	800-433-8442*	San Diego—W. P. (Bill) Shine	619-573-7384*
Post office box—50263, St. Louis, MO 63105			
AMSEA/QUINCY		FORT WORTH	
Quincy—James F. O'Hearn	617-786-8300 ext. 702	Fort Worth—John L. (Jack) Shultz	817-777-1400*
		Abilene—Robert E. Davidson	915-691-2131*
CESSNA		FREEMAN UNITED COAL	
Wichita—Mark Bagley	316-946-7880*	Marion—James T. Ryan	800-637-0399*
CONVAIR		GD SERVICES	
San Diego—John C. Barrons	619-573-8120*	St. Louis—Doris Chiste	314-851-8997*
CORPORATE OFFICE		LAND SYSTEMS	
St. Louis—Kent Druyvesteyn	314-889-8456*	Detroit—Charles J. Stieber	313-825-5888*
Washington—William L. Smith	703-553-1343*	Lima—Thomas E. Ansley	419-221-8555*
DATA SYSTEMS		Scranton—Richard W. Gray	717-876-5797*
St. Louis—William E. Tucker	314-851-8906*	MATERIAL SERVICE/MARBLEHEAD LIME	
Camden—John Brown	501-574-4220	Chicago—Edward K. Wilverding	800-225-0926*
Fort Worth—D.G. (Dee) Chamberlain	817-762-7014*	POMONA	
Newport—Edwin A. Coolbaugh	401-848-8650	Pomona—Roy E. Harris	714-868-2001*
Norwich—James M. Cleary	203-823-2700*	Camden—C.R. (Bob) Ingels	501-574-4446*
Pomona—William E. Kirke	714-868-6620*	SPACE SYSTEMS	
San Diego—John W. Withers	619-547-4682*	San Diego—Alda O. Jorgenson	619-573-8367*
Sterling Heights—Carol J. Hussey	313-825-8629	Cocoa Beach—Howard F. Biegler	407-730-0185*
ELECTRIC BOAT		Vandenberg AFB—Ray Degen	805-865-8072*
Groton—William A. Miller	203-433-8000*	VALLEY SYSTEMS	
Avenel—Robert L. Wylie	201-636-0155*	Rancho Cucamonga—Bill Coleman	714-945-7772*
Charleston—Cheryl A. Lyons	803-553-4850*		
Quonset Point—Roland J. Plante	401-268-2705*		

Lehman letter sparked ethics planning

There was little cause for fanfare when General Dynamics started its ethics program five years ago. Times were not the best when Chairman and Chief Executive Officer David S. Lewis issued an executive memo on Aug. 13, 1985, kicking off the program.

Then-Secretary of the Navy John Lehman Jr. told the company in a letter dated May 21, 1985, to "establish and enforce a rigorous code of ethics for all General Dynamics officers and employees with mandatory sanctions for violation."

Oliver C. Boileau, then president of General Dynamics, managed the effort to establish a code of ethics. A team of employees from several departments at the Corporate Office finalized the foundations of the program less than three months after Lehman's letter.

The ethics program evolved from concept to full-fledged operation as it passed a series of milestones:

How ethics program works

If you have a question or concern about the meaning or application of "General Dynamics Standards of Business Ethics and Conduct:"

1. Talk to your supervisor.
2. If this approach is unsuitable or unsuccessful, call your local or corporate ethics program director or write to the St. Louis post office box.
3. The ethics director will listen and attempt to respond to your questions or concerns.
4. Expect a response and call again if one is not received within a reasonable period of time.
5. You may remain anonymous if you choose.
6. Confidentiality will be safeguarded and your identity will not be revealed without your permission.
7. No reprisals will be taken against you for using the hot line.

1985: Lewis issues memo in August that starts the program. A network of part-time division ethics directors is formed that same month. Distribution of "General Dynamics Standards of Business Ethics and Conduct" to all employees begins in September. Kent Druyvesteyn, dean of students and director of the master of business administration program at the University of Chicago's School of Business, is hired in October as corporate ethics program director. The ethics hot line starts and a corporate policy and procedure for the program is issued in December.

1986: Four more corporate policies and procedures for ethics are completed in April. General Dynamics signs the Defense Industry Initiatives, which commits the company to an annual outside audit of the ethics program, in June. By year's end, all but 1,000 of the company's 99,000 employees have received ethics awareness training. Most defense division ethics directors positions have been upgraded to full-time. Ethics directors are contacted 3,646 times by employees. Company imposes 123 sanctions.

1987: The personnel ombudsman program and a no-reprisal policy against hot line users are established in March. A second edition of the ethics standards begins distribution to all employees in October. Employees make 5,482 contacts with ethics directors. There are 205 sanctions.

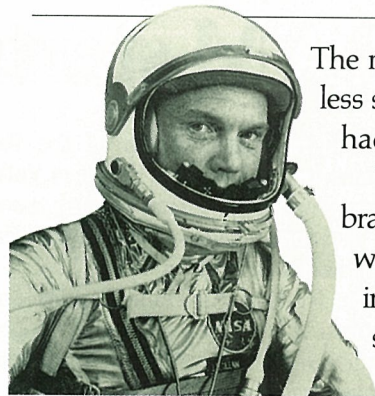
1988: Ethics directors receive 5,379 inquiries from employees. Sanctions total 206.

1989: Employees make 4,955 contacts. Sanctions number 257.

Over the years, the ethics program has become an important part of General Dynamics' business conduct. The program's role in the company will go on.

"General Dynamics' commitment to its ethics program will continue," said Vice Chairman William A. Anders, who will become chairman and chief executive officer on Jan. 1. "It has served the company well and I see no need for any significant changes."

THEY SAY IT'S GOING TO FLY. OF COURSE, THEY AREN'T GOING



On February 20, 1962, the Atlas of Friendship 7 boosted the first American, John Glenn, into Earth orbit. His historic flight was the 117th for an Atlas.

The machine had stainless steel skin. The men had steel nerves.

The men were the brave Americans who waited, strapped into a cramped capsule atop 125 tons of explosive fuel to be blasted into orbit.

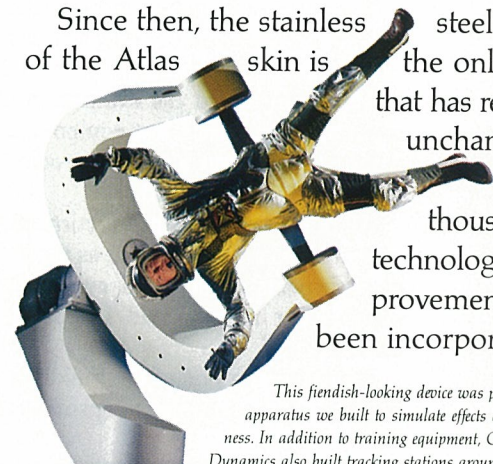
The machine was originally America's first intercontinental ballistic missile, developed by General Dynamics in the early 1950s, and for nearly 10 years the free world's only deterrent weapon.

The men were the Mercury astronauts.

The machine was our Atlas rocket.

Their histories merged in the early 1960s, when General Dynamics began reconfiguring Atlas to launch payloads into space for the Air Force and NASA.

Since then, the stainless steel sheen of the Atlas skin is the only thing that has remained unchanged, a literally thousands of technological improvements have been incorporated.



This fiendish-looking device was part of the apparatus we built to simulate effects of weightlessness. In addition to training equipment, General Dynamics also built tracking stations around the globe.

s fifth year as employees' 'listening device'

III. Enforcement: Those caught violating the company's ethics standards face action matching the seriousness of the infraction. Sanctions in order of increasing severity consist of warnings, reprimands, probations, demotions, temporary suspensions and discharges. In addition, refunds are sometimes required for losses or damages, or cases are referred for criminal prosecution or civil action.

Investigations begun through the ethics program since 1985 have resulted in 922 sanctions, including 125 firings, 49 required refunds and six referrals for further legal action.

Sanctions represent only a negative and statistically small segment of the ethics program. "While everybody is for ethics, people tend to focus on violations and suspensions," Druyvesteyn said. "But there is something positive about ethics. The program attempts to appeal to the highest values employees bring to the workplace."

Outsiders view sanctions as a measure of the ethics program's success. Druyvesteyn, who handles many media interviews — all unsolicited — is often asked how many employees have been "caught" and "fired."

However, there are positive indications of the program's effectiveness. Heavy use of the program's hot lines and post office box shows workers are aware of the program. Employees and the company have benefited: The program helps answer individual questions or concerns; it gives an early warning of concerns emerging in the work force; and it helps shape company policies and procedures.

In addition, the program is reviewed annually as part of the company's voluntary participation in the

Defense Industry Initiative. General Dynamics answers in writing the Initiative's 20 questions about the ethics program; the replies are verified by the company's independent accountants, Arthur Andersen & Co.

Perhaps the most prominent testimony on the program's effectiveness came from John Lehman Jr. when he resigned as secretary of the Navy in 1987. Just two years earlier, after investigations of alleged mischarging at Electric Boat Division, Lehman had demanded that General Dynamics institute a code of ethics if the Navy was to end a suspension of payments on Navy contracts with the company.

In March 1987, Lehman told *The New York Times*,

Confidentiality and ban on reprisals are vital

Employees' biggest misconceptions about the ethics program are confidentiality and reprisals, division ethics directors say.

Ethics directors will not identify a hot line caller to a third party without the caller's permission. No action will be taken against callers for using a hot line. "The success of the program hangs on those two threads," said John Barrons, Convair Division ethics director.

Still, some workers doubt the confidentiality of the program, and in last year's survey of employees, 38 percent of respondents believed they would be hurt in some way for using an ethics hot line.

Countered Jerry Sills, until recently Fort Worth's ethics director: "I'm convinced that the company is doing everything we can to protect confidentiality. We go to extreme measures to do so."

"There is not a better relationship today between the Navy and a contractor, and I would submit between any service and a contractor, than we have with Electric Boat."

While Lehman's stamp of approval is encouraging, the ongoing need for the ethics program remains. "You'd like to see the ethics directors disappear and have matters dealt with normally in the employee-supervisor relationship," said Bill Coleman, Valley Systems ethics director. "But until that happens, there needs to be someone at the other end of the phone."

Coleman and his counterparts will be there. Listening.

Added Valley Systems Ethics Director Bill Coleman: "Confidentiality does get compromised, not by the ethics director, but by people who lodge the complaints. They tell their friends they've called the hot line, and pretty soon it's all over the shop. So the people who use the hot line also must ensure confidentiality."

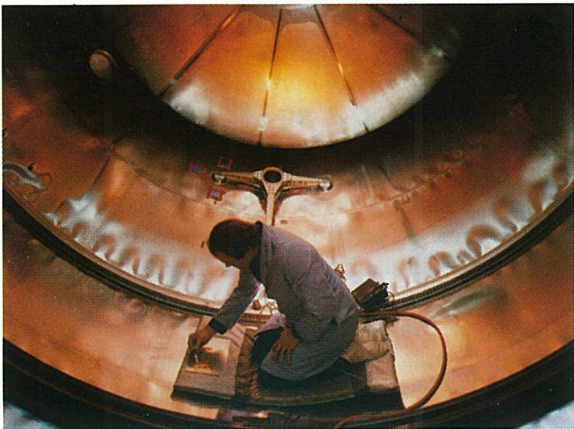
General Dynamics has a policy prohibiting reprisals, said Kent Druyvesteyn, who directs the corporatewide program as staff vice president-ethics. "We have demonstrated that the policy is the practice of this company," he said. "But as indicated by the employee survey, there is a sizable minority who doubt that. Our first priority, therefore, is to make sure reprisals don't occur and to prove our commitment by our actual performance."

Ethics stories by John Corrigan and Dave Lange



Atlas has boosted virtually every U.S. weather satellite. In December 1958, it boosted the world's first communications satellite, Project Score, which circled the globe broadcasting President Eisenhower's Christmas message. Atlas went on to launch 36 more communications satellites, and dozens of scientific probes, including Pioneer, Mariner, and Surveyor, the first American spacecraft to soft-land on the moon.

With a record of 496 launches, our Atlas is one of America's most successful and reliable launch systems.



Inside the stainless steel skin of a Centaur upper stage, one of our craftsmen measures expansion and contraction stress. Unique technology makes the Atlas/Centaur the most efficient launch vehicle in use today.

Our 30-plus years of experience and the dedication to excellence of the Atlas team are especially important now.

In one of the largest commercial space ventures in history, General Dynamics has committed to the production of 62 new Atlas vehicles for government and business missions.

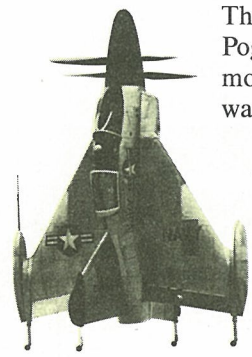
For over three decades, Atlas has made history in space.

And paid dividends here on Earth.

GENERAL DYNAMICS
A Strong Company For A Strong Country

No Pogos allowed

All together now: 'integrated development' at Fort Worth



The pilot of the 1950s-era XF-104 Pogo, one of General Dynamics' more unusual design attempts, was expected to look over his shoulder while making a vertical landing—tail first—on the deck of a ship.

Aviation history books mention this as a footnote to the fact that the Pogo worked, "but not very well."

The XF-104 Pogo Test pilots were less than enthusiastic about a rear-view landing approach. It's probably safe to say they didn't have much input during the aircraft's early design process.

That was in the days before integrated product development.

Fort Worth Division's Integrated Product Development Critical Process Team, a key part of the division's overall total quality management effort, is ensuring that future aircraft designs meet producibility needs, maintainability standards and all other parameters that add up to the crucial bottom line of customer satisfaction.

"It's a division-level approach to doing things that people used to think of as strictly engineering tasks," said project engineer Tom Bennett, chairman of the team. "The concept was originally known as concurrent engineering, but we changed the name to integrated product development to reflect broader participation in the design process."

The 16-person team includes representatives from the engineering, production, materials, quality assurance, logistics, Advanced Tactical Fighter and A-12 organizations.

"The process will be used at the very beginning of product development when we start with a mission statement for a new hardware system in response to a customer's need," said Bennett. "The end of the process will be a final set of detailed specifications for products, equipment, processes and all the other elements needed to start production following the customer's go-ahead."

The team's goals are to reduce cost and development time while improving quality, Bennett said.

After starting work last September, the team defined the current design process and network of interactions at the division. This flow chart and a concept for an improved process have been presented to Edward M. Petrushka, vice president-research and engineering.

The concepts of integrated product development are being applied to F-16 model improvements and the Advanced Tactical Fighter, although those projects were well under way before the team started work. "The specific goals of integrated product development are very high," Bennett said. "To achieve the greatest benefit you should probably apply it from the very start of a program."

An integrated product development team is leading full-scale development of a second-generation F-16 Improved Avionics Intermediate Shop set, which tests the aircraft's avionics. The Electronics Division, manufacturer of the set, will also be involved.

Bennett said a future task—designing a new aircraft to replace the F-16 as the Air Force's multirole fighter—could turn out to be the first real test of the total integrated product development process. "The multirole fighter program is in its infancy," he said. "If the Air Force decides to proceed with conceptual design, it will be our first total integrated product development program."

The Department of Defense already recognizes the potential benefits of the concept: Integrated product development is required for new programs such as the Advanced Tactical Fighter's full-scale development phase.

"The whole point is to make sure you understand what the end product looks like before you start building details," Bennett said.

In hindsight—pardon the pun—one can only wonder if the XF-104 Pogo's designers knew as much about where they were going.

■ Joe Stout

(From left) Beth Paul, Bill Dingler, Rich May, Mark McDonald and Jorge Cornejo apply integrated product development principles to drawings for a fighter aircraft canopy frame component.



NEAL CHAPMAN

Valley Systems task force curtails hazardous chemical usage

An employee task force is successfully tackling a trio of threats at Valley Systems Division.

Environmental abuse, high costs and hazardous chemicals are under assault by the 10-member team formed by Vice President-Production Len Stuessel and Manager-Environmental Resources Management John Grosskopf.

Freon has generated the three threats. Valley Systems uses Freon primarily in vapor degreasing, which removes contaminants such as oil and fingerprints from metal assemblies, hybrid microelectronics assemblies and printed circuit boards.

However, Freon is a chlorofluorocarbon that depletes the ozone layer and contributes to global warming. The U.S. Environmental Protection Agency is limiting production and use of chlorofluorocarbons to 1986 levels in accord with an international agreement. In July 1989, Valley Systems was allotted 217

drums of the chemical, or 80 percent of its 1988 Freon purchases. And in the last half of 1989, the price of Freon rose from \$700 to \$1,900 per drum.

Those factors prompted the division to form the task force to improve processes that use Freon. Kim O'Rourke of environmental resources management coordinates the team. Its other members are Paul Atkinson, hybrid microelectronics manufacturing engineering; Ron Barker and Kelly Borkenhagen, procurement quality assurance; Bruce Bias, material control; Lisa Hammond, applied research; Dave Hatfield, maintenance and plant management; Dave Martinez, Rolling Airframe Missile manufacturing engineering; Joe Spellman, electro-optical machine shop; and Mike Taylor, inventory stores.

The task force has put in place three short-term solutions to reduce usage and conserve Freon:

► Train operators on degreaser cleaning methods.

► Have quality assurance test solvent in degreasers before changing Freon to reduce unnecessary disposal.

► Utilize recycled Freon.

These actions have reduced Freon use 60 percent in vapor degreasers and are saving approximately \$2,000 per week.

The task force is also concerned with long-term corrective actions and will focus on substitutions for Freon through water-based cleaners and non-solvent cleaning processes.

These efforts "will eliminate Freon usage far in advance of the end-of-the-century timetable expected by the Environmental Protection Agency," Grosskopf said. "It is a bold statement, but one that is achievable. This represents the division's ongoing commitment to reducing Freon usage and protecting the environment."

■ Jerry Littman

Scranton plant wins Pennsylvania award for waste reduction

A dramatic reduction in hazardous waste generated by Land Systems Division's Scranton facility has caught Pennsylvania's attention.

The governor's office recently presented Scranton with a Waste Minimization Award. The facility, located near Scranton, Pa., has cut hazardous waste generation from 1,122 tons in 1984 to 7.5 tons for the first half of 1990.

"To achieve these results, we used a three-step process of inventory, evaluation and control," said Bea Hamor, division environmental resources management program manager. "Incoming hazardous materials are carefully monitored to reduce the amount of waste produced. We also evaluate potentials for material substitution. For instance, a trichloroethane vapor degreaser was replaced with a washer system that uses a non-hazardous detergent. We also collect waste coolants that are reconditioned and used again rather than discarded."

Pennsylvania Gov. Robert P. Casey presented the award to Hamor and Nelson Harvender, senior engineer-facilities at Scranton. The governor's office gives awards annually to communities and companies that have innovative programs to reduce household, residual or hazardous waste in Pennsylvania. Scranton was one of 10 winners this year.

Programs are judged on their economic and environmental benefits and future use by other industries or municipalities. The awards program is divided into industrial and municipal categories. The industrial category is targeted at companies that produce residual or hazardous waste, while the municipal category concentrates on recycling programs for household waste.

Judges included state officials and technical experts. "Finding new and better ways to dispose of trash is vital to the protection and preservation of our environment," Casey said. "These award winners have demonstrated that waste reduction, reuse and recycling not only make good environmental sense, but good economic sense as well."

General Dynamics established a comprehensive environmental resources management program in 1984. It addresses waste minimization, equipment containing polychlorinated biphenyls (PCBs), underground storage tanks, air and water discharges, asbestos management, solid waste and hazardous material replacement.

■ Donald L. Gilleland

Pollution presentation popular with students

About 1,000 youngsters in Fort Worth heard about such topics as recycling and ozone layer depletion, thanks to five General Dynamics employees who took an environmental message to local schools this spring.

The group, all members of Fort Worth's environmental resources management team, began the visits in April to promote Earth Day. The talks were so successful that the schools continued to schedule them until summer break. The group visited nine schools.

"The students were very enthusiastic and much better informed than most of us had expected," said Stephen Evanoff, an environmental resources management employee and organizer of the effort conducted under auspices of the Fort Worth Independent School District's Adopt-A-School program.

"The students' interest is probably something the teachers fostered over time," he said. "The teachers seemed to appreciate the opportunity to have someone in their classrooms with hands-on experience from the industrial side (of environmental science)."

"A lot of the classes were already planting trees and recycling things. As visiting instructors, we just tried to build on their interest and act as cheerleaders."

Another volunteer instructor, Jill Parker of the material response department, said the discussions covered subjects such as acid rain and basic conservation measures the students can take at home. "We stressed that everybody needs to be involved in preserving the environment," she said.

Other employees making the presentations were Larry Kirschner, Gretchen Brumbaugh and Kathy Singer. The group expects to continue the school presentations next fall, Evanoff said.

■ Joe Stout



Emily and Lou Voelkel stand near the Faisal Mosque, the largest in the world, in Islamabad.

Family preparation helps life overseas

Foreign sales represent a significant portion of General Dynamics' business. The company supports its foreign programs by sending U.S. employees to train and work with their counterparts in each country. This story describes the preparation General Dynamics Services Co. gives its employees going on foreign assignments.

Emily Voelkel told herself to be ready for anything when she accompanied her husband, Lou, last December to his assignment with General Dynamics Services Co. in Pakistan.

So she wasn't taken aback the first time she saw a herd of cattle passing down a Pakistani street. "Some of the things you see can be surprising," she said. "But if you prepare yourself to expect anything, you find out it's not quite as bad."

Preparation is the key for anyone about to join the 250 Americans who work for General Dynamics



A Pakistani girl carries her brother.

Services Co. in eight foreign nations. Formal pre-departure orientations by the company and employee-organized support groups overseas combine to ease adjustment to a new culture.

Such preparation has become an essential element of operations at General Dynamics Services Co. The number of Americans it employs overseas has doubled the last four years. "GD Services Co. is very experienced with overseas deployment," said Lou Voelkel, program manager for the depot where Pakistanis rebuild U.S.-supplied M-series armored vehicles. "The process has become so routine that we have a high success rate with first-time overseas employees."

Preparation begins with supervisors in the United States who choose people for foreign assignments. While technical qualifications are important, overseas candidates must also have the potential to adjust to other countries' cultures. Supervisors seek open-minded, flexible and patient as well as technically capable people.

Cross-cultural training is also given to those chosen for foreign assignments. Peter Collins, for example, learned about Egyptian customs in a company-sponsored three-day course at the University of Detroit



Buyers and sellers mingle in a Pakistani market.

before leaving for Cairo as supervisor-facilities engineering on the M60 tank program. Pakistan-bound employees receive orientations before departing the United States and continue orientations upon arrival.

Even with preparation, the transition to life in a new land can still unsettle an employee, especially one on first-time overseas assignment. The most important message from company orientations and from those overseas: Assimilate the culture to thrive. "You just can't compare this place to the U.S.," said Dave Gadd, a manufacturing engineer in the Egyptian tank program. "It's a different way of life, and you just have to accept it."

For instance, although native food is cheap and plentiful, it usually requires thorough cleaning. Work is interrupted several times each day for mandatory prayers in Islamic countries.

"A lot of Americans come over here and want to get everything done in five minutes," said Ken Gutzman, a facilities engineer in Pakistan. "You have to be patient."

Wives of overseas employees probably face the hardest adjustment. For example, the women's movement is just beginning in other parts of the world. "There are certain jobs I can work at, but not in a regular Pakistani establishment," Emily Voelkel said. U.S. embassies are prime sources of jobs and volunteer work for wives. Voelkel spends her days learning Urdu, the official literary language of Pakistan; shopping with other employees' wives; and writing friends.

The embassies offer activities for children. Top-notch schools are available. The company pays the tuition for the Voelkels' 7-year-old Josh at the International



A General Dynamics employee and family reside in this house in Pakistan.

School of Islamabad. "The curriculum is better than in the States," Emily Voelkel said. "It's very tough on reading and math, and 13 is the largest number of students in a class."

Another company benefit for overseas employees is lodging. In Pakistan and Egypt, the company provides or subsidizes employee housing.

Pay, travel and time off are other pluses. In addition to their salaries and foreign assignment pay premiums, overseas employees in Pakistan and Egypt receive travel allowances for periodic rest times and home leaves to the United States.

Those who thrive overseas credit company orientation and mental attitude. "The company prepared me as well as possible," said Collins, who recently signed for an extension to his Egyptian tour. Added Lou Voelkel, "You need competence to do the job, but it's just as important to be adaptable. People who are easygoing, laid-back, straightforward and honest have no trouble overseas."

■ Dave Lange



Exhausted Freeman mine tract is one to grow on

A 2-MILE-LONG road of crushed rock takes vehicles from a rural highway to the office at General Dynamics' Freeman United Coal Mining Co. surface mine in Industry, Ill. Freeman Vice President Dale Walker likes to stop his car on that road when he has a first-time visitor along during the summer. Walker points to the surrounding fields. They are nearly flat and filled with golden wheat waving in the wind.

"There was a surface mine here a couple years ago," Walker says.

While the passenger lifts his chin off the seat, Walker explains that Freeman leaves no ugly scars in the earth. In fact, the land is better than before Freeman opened it and dug 70 feet down to reach coal. The 5,000 acres belonging to Freeman at Industry were either wooded, ravined or farmed in small plots. But when Freeman exhausts a cut of coal, it painstakingly replaces the bottom level of rock, the middle strip of clay and the top layer of soil, grades it flat and sows it with wheat, corn or alfalfa.

The result: Freeman's Industry site annually yields thousands of bushels of wheat and corn and thousands of tons of hay in addition to 500,000 tons of coal.

Land reclamation of surface coal mines is mandated by law. "It used to be that most of this land would have been put back as pasture," Walker says. "Much more is put to agricultural use today."

The state of Illinois requires a surface coal mining company to show that mined land can be cultivated. The company must post a state bond containing conditions the company must meet before it can sell or lease the land it has used. The bond requires that the company grow three kinds of crops on the used land and meet annual production minimums for each crop at least three times over 10 years. If those standards are met, the state releases the bond money and the company can dispose of the land.

This is Freeman's eighth year of mining and fifth of crop-growing at Industry. In 1989, Freeman met its production minimum for all of its wheat, nearly all of its alfalfa and eight of 10 cornfields. Two full-time farmhands, Chuck Hillyer and Gene Icenogle, handle all the agricultural work except harvesting. Harvesting equipment is so expensive that it's cheaper for Freeman to hire self-equipped tenant farmers to bring in the crops. Freeman sells its harvest at market prices.

Freeman has paid tenant farmer Mike Woodside to work its lands for the last 24 years. In early July he was combining wheat in Industry, looking for all the world as if he was in the middle of the Kansas plains — except for the hundred-foot-high excavating equipment digging in a surface mine a few hundred yards away.

"The quality of the crops here is really pretty good, except for the mold this year," Woodside says during a break in the harvesting. Industry had already surpassed its average annual rainfall by midyear. Heavy rains — including one June storm that dumped 6 inches of water — wet land and resulting mold will combine to cut wheat production probably in half. But that doesn't

mean Freeman won't meet its state-imposed minimum, and all the farmers around Industry are coping with the same weather.

Weather or not, Freeman works as hard at farming as it does at coal mining. Its Industry mine operates every hour of every day of every year to produce coal that is trucked to Quincy, Ill., about 50 miles away on the Mississippi River. The coal is barged to Muscatine, Iowa, where it is consumed by a municipal utility.

Meanwhile, Freeman's farmhands are working about 1,000 acres. Hillyer and Icenogle sow wheat in October and plant corn in May. Alfalfa yields three crops of hay each year, wheat is combined in July and corn is

harvested in October or November. The fields also require fertilizing.

Some of the corn is planted by injecting seeds into undisturbed earth rather than by tilling the land. No-till farming is a fairly recent development that eliminates wind erosion of tilled topsoil. No-till is one example of Freeman's efforts to go beyond requirements of the law.

Another is a state plaque in the mine's office that hails Industry as best in land reclamation in Illinois in 1987.

"If you would have seen this land before we started mining, you wouldn't have believed it," says Don Tippey, superintendent of the mine. "There were just little plots here and there, and the rest was just rolling land and woods."

The land is still unbelievable, but for far different reasons. Freeman is making a once-desolate piece of Illinois resemble an agriculturally rich portion of Iowa or Kansas.

■ Dave Lange



Above: Don Tippey, left, and Dale Walker examine the corn crop growing on reclaimed mine land.

Top: Wheat is combined on former mine land in Industry, Ill., while equipment in the background digs for coal. The mounds of earth are topsoil that has been removed during the mining process and will be replaced when the land is reclaimed.

Reclaimed land shows that mine ground can be useful

Don Tippey will complete more than 44 years in coal mining when he retires as superintendent of Freeman United Coal Mining Co.'s mine in Industry, Ill. When that time comes, he'll leave proud of the land reclamation Freeman has done.

"So many people think that a mine comes in and just rips up the ground," Tippey says. "That's a misconception. This shows that mine ground can be useful."

There will be no useless land left outside of this rural Illinois town. Rather, there will be more productive farmland, wetlands for wildlife, ponds and dry dam erosion

control structures than there were when Tippey arrived here a decade ago.

After Tippey leaves Freeman to enjoy some fishing and woodworking, this mine will still be productive.

Tippey came to Industry with the initial crew in 1980. Coal shipments began in 1982. Before mining could start, crews had to remove timber from the rolling terrain. Tippey's office sits where the first tree was removed, and a piece of that tree's trunk hangs on the wall.

Coal mining is not an easy task, yet Tippey describes the process as simple. "After you've worked in and around mines for more than 40 years, it becomes everyday practice," he says.

Three layers must usually be removed to reach coal for surface mining at Industry. The topsoil, 18 inches deep, is the first and must be carefully stored in mounds to be replaced later. The second is a mixture of dirt and clay up to 20 feet deep. Then 40 feet of rock is blasted through to reach the 27-inch-thick seam of coal.

After the coal is removed, the land is restored by heavy equipment. Before mining, the topography in this area was so uneven that erosion had reached below the level of the coal in some places. When Freeman restores the land, the terrain is smoothed and the topsoil is spread evenly so that all of the land can be planted.

Tippey didn't learn coal-mining techniques from a textbook. He built his career from an education in the "school of hard knocks." He was "just a kid who went to work for the company," he says. "I started in the union and worked my way to where I am today."

As his mining years end, Tippey can be proud that he left the land at Industry more productive than before. "It is self-satisfying to look at land reclamation and to have wheat and crops grow on mined ground," he says.

■ John Corrigan

GENERAL DYNAMICS

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The YF-22 is displayed in Palmdale, Calif.

ATF prototype goes public

The YF-22, designed and manufactured by the team of Lockheed, General Dynamics and Boeing, was unveiled Aug. 29 at a news conference in Palmdale, Calif.

The two-engined aircraft is one of two prototypes that the team has built under an \$818 million contract from the Air Force for its Advanced Tactical Fighter.

First view of A-12 – page 7

Flight testing of the single-seat aircraft was to begin this month at nearby Edwards Air Force Base, Calif.

The contract to develop the Advanced Tactical Fighter was awarded to the team in October 1986. The team will

submit its proposal for full-scale development and production in December to cap the 54-month demonstration-validation phase.

The Air Force will select the winner next spring. The YF-22's competitor is the YF-23 from Northrop and McDonnell Douglas.

Gen. Robert D. Russ, commander-Tactical Air Command, said 750 of the fighters would be eventually delivered. The Navy is considering a variant of the aircraft and has said that 550 might be procured.

The Advanced Tactical Fighter is planned to replace the F-15 Eagle. The new plane is being developed to

(Continued on page 4)

Kentucky's undampened spirits christen newest Trident submarine

There was no mistaking the tenor of the christening ceremonies for the Navy's newest Trident submarine. It was strictly one of Southern hospitality.

With the melodic strains of "My Old Kentucky Home" echoing on the docks, *Kentucky* (SSBN 737), the 12th Trident ballistic missile submarine, was christened Aug. 11 at Electric Boat Division in Groton, Conn. Even a torrential downpour didn't dampen the occasion.

With a sense of pride whose heritage includes the likes of white-suited colonels, thoroughbreds, mint juleps and the Kentucky Derby, the participants provided a unique christening. A large contingent of Kentuckians, many of whom were bused to Electric Boat the day before, wit-

nessed the event.

The christening bottle represented a fitting honor for all Kentuckians. When the ship's sponsor, Carolyn Pennebaker Hopkins, broke the bottle over the ship's sail, it was a blend of Kentucky bourbons—not the traditional champagne—that oozed down the ship's side.

Eight Kentucky distilleries—Ancient Age, Jim Beam, Old Forester, Old Charter, Very Old Barton, Heaven Hill, Wild Turkey and Kentucky Taverns—combined their most seasoned bourbons in one bottle for the occasion. It was the first time bourbon has been used to christen a Navy ship.

(Continued on page 4)

Two more commercial launches lined up

General Dynamics Commercial Launch Services Inc. recently signed contracts for its 23rd and 24th commercial launches.

One contract is with the Italian Space Agency to lift the X-ray Astronomy Satellite in 1994. The other is with General Electric to launch its BS-3H direct broadcast satellite in April.

Both satellites will be carried by Space Systems Division's Atlas I rockets from Launch Complex 36 at Cape

Canaveral Air Force Station, Fla. The 2,868-pound X-ray Astronomy Satellite will study X-ray emissions. The 2,940-pound BS-3H satellite will beam television signals to small satellite receivers in Japan.

General Dynamics is committed to building 60 Atlas launch vehicles for commercial and military markets. The company is under contract for 10 Air Force launches in addition to the 24 commercial orders.

Col. Henry Crown, major figure in GD history, dies at 94

Col. Henry Crown, a co-founder of Material Service Corp. who twice was the primary person responsible for reversing General Dynamics' declining business fortunes during the 1960s and '70s, died Aug. 14, 1990, after a long illness. He was 94.

"Henry Crown personified the best of American business entrepreneurship," said Chairman and Chief Executive Officer Stanley C. Pace. "He will always be remembered, not only for his extraordinary business acumen, but also for his uncommon generosity and his love of people."

Photos, story – page 5

Col. Crown played the dominant role in solving serious financial and management problems within General Dynamics after it merged with Material Service in 1959. In 1970, four years after the then General Dynamics management redeemed his preferred shares, he had repurchased enough common stock to own a substantial interest in the company. He became chairman of the executive committee of the board of directors and prevailed upon David S. Lewis to join the company as its chief executive officer. Lewis led General Dynamics through 15 years of growth and profitability.

Col. Crown retired from the board of directors in 1986 but continued as honorary chairman until his death. His son, Lester, and grandson, James, are members of the board of directors and Lester is an executive vice president and chairman of the executive committee of General Dynamics and chairman of Material Service Corp.

In addition to his son and grandson, Col. Crown is survived by his wife, Gladys; another son, John, a Cook County (Ill.) Circuit judge; 15 grandchildren; and 10 great-grandchildren.

News Briefs

Cessna lands in Milwaukee

Cessna Aircraft Co. has opened its seventh company-owned Citation Service Center. The facility is located in Milwaukee and is expected to draw customers from a five-state area where some 125 Cessna Citation business jets are based.

The 45,000-square-foot facility is equipped to handle all Citation models, including their avionics systems. Approximately 30 employees staff the center. That number is expected to double within a few months.

o o o

Digital data help available

General Dynamics is a founding member of the Computer-aided Acquisition and Logistic Support Connectivity Center, created to assist industry initiatives in computer-aided acquisition and logistics support.

The center's services are available to the entire corporation. The center can assist with education and demonstrations of digital data management.

George Kaler, Fort Worth's director of information resource management, and Bob Gilbert, deputy project manager, are contacts for the center. Gilbert can be reached at (817) 777-1819.

o o o

Supplier wins scholarship

Austin Crawford, vice president of Bay City Marine Corp., has received a General Dynamics scholarship to attend the one-week Minority Business Executive Program at Dartmouth College. Crawford's company supplies tooling fixtures to Space Systems Division.

Current & Comment

Lest we forget

There's no better teacher of geography than an international crisis. This is particularly true in America where, with the possible exception of TV game show competitors, our knowledge of far-away places is paltry at best. It's been estimated, in fact, that only one in about 300 of us can locate three nations in South America or Africa—and identifying European and Asian countries/cities is no less challenging.

These days, however, a lot of us have a reasonably accurate mental geographical imprint of the Persian Gulf hot spot. We can pinpoint tiny Kuwait, dangling like a fuse at the tail end of the Middle East mine field that is Iraq. Middle-aged stamp collectors know this Tigris-Euphrates valley as Mesopotamia. Biblical scholars know it—with some irony—as the site of the Garden of Eden in the Book of Genesis. We can now also flag Turkey and Saudi Arabia, beyond Iraq's northern and southern borders, where our military is billeted.

As American men and women dig in some 6,000 miles distant, major print and electronic news-gathering organizations in the United States scurry to interview citizens whose views on involvement in this crisis are at odds with their government's. From a reporter's perspective, one great advantage of a democracy (as it should be) is that there is always a healthy supply of outspoken "upstreamers" impatient to challenge presidential action, even when the tide of public sentiment may be running strongly in White House favor.

Opinion journalists, who also know the resale value of controversy, are similarly free to scatter seeds of dissent in their columns. "Not our problem. Stay out of it," they urge. "Let's not overreact." Their words bring to mind the cartoon bar patron standing in wide-eyed horror as another customer lunges at him, brandishing a broken bottle. "Ignore him," remarks the bartender, toweling glasses.

It's clear from history, however, that one cannot ignore the bullies of the world. As we see today, they need to be confronted by the united resolve of governments, the dedication and skills of our military, and the superior technological performance of weapon systems produced by our employees and others. (GD-built products from almost all of our operations are providing land, sea and air protection in the Gulf.) Most of all, history teaches that procrastination invites defeat. As our president knew well, immediate and decisive action must be taken when the other guy goes for his gun.

Most Americans, deficient as they might be in geography, are better with history. They understand that some situations can't be second-guessed. They understand and fully support our stand in the Gulf. And many remember other historical events that called for a swift, strong and unqualified response.

My 81-year-old English father-in-law, who survived considerable combat as a tail gunner on an RAF Lancaster bomber during World War II, was a recent guest at Buckingham Palace. Together with a hundred or more of his fellow veterans who defended their homeland 50 years ago, he was received by Queen Elizabeth and Prince Philip on the palace lawns and served tea and sandwiches. This was a memorable happening for these elderly gentlemen, many of whom now reside in RAF-affiliated convalescent homes near London. The event was arranged by a small group known as the "Lest We Forget" association, a name that could well serve as a watchword for the entire Free World today. ■ Peter K. Connolly

Company studies worker diversity

General Dynamics employees come from many cultures and backgrounds. There are scientists with doctorates and workers without high school diplomas. There are multilingual individuals and those unable to read or speak English.

Approximately 75 percent of those entering the work force will be minorities and women.

Projections show diversity among employees will increase dramatically over the next 10 years. Approximately 75 percent of those entering the work force will be minorities and women from various backgrounds and cultures, creating a shift in values and priorities. General Dynamics has established a task force of corporate and division representatives to lay the groundwork for an employee diversity program.

"Our challenge is to have an environment that recognizes and builds upon the personal and occupational needs of a diversifying work force," said Arch Rambeau, corporate vice president-human resources. "The company that succeeds in managing diversity in the workplace will have a competitive edge in the future."

"An appropriate environment will enable the company to better meet its business objectives and the needs of our employees."

Discussions have included such areas as child and elder care, literacy problems and health and welfare. "Diversity is a reality today at General Dynamics," Rambeau said. "We must understand the different attitudes, cultural backgrounds, values and lifestyles of our employees. We must manage diversity, or it will manage us."

One of the initial phases of building the appropriate environment has been the development and initiation of several diversity training workshops. These sessions "begin to get people thinking about the future and increase their levels of sensitivity to different backgrounds and cultures in their ranks," said Larry Nelson, Convair Division engineering director, at a recent training session.

Nelson joined John Barrons, Kathy Chin and Cal Samuels of Convair, Fran Richardson of Space Systems,

and Percy Meyers of Electronics in setting up the training program. The session dealt with population statistics and projections as well as perceptions of people.

"The bottom-line message of the training session is that you can make the difference," Nelson said. "The vision we should each have in our mind is an image of fully tapping the human resource potential of every member of the work force. That will require growing awareness of the needs, skills and cultural backgrounds of each of our employees."

Added Bill Persky, corporate director-safety and health, who has overall responsibility for the diversity program: "We must be prepared to treat fairly those whom we will depend upon in the future. If we expect to retain the best people, we must have a diversity program in place."

Persky noted that the employee diversity program "recognizes everyone should be treated as an individual while recognizing a person's ability to contribute to the company's success. This requires a whole new set of management and leadership skills as well as flexible policies to meet the needs of the individual."

Research indicates that between 25 and 30 percent of the work force has the responsibility of caring for elderly relatives, adding stress and time away from work. The diversity program is studying dependent care, led by Anne Serra, corporate manager-human resources special projects.

"We used to tell employees to leave their problems at home," Serra said. "However, we have learned that home and work affect each other. We need to help our employees successfully balance those two important aspects so that family and work benefit."

Investigation and development of child care resource and referral centers have already taken place. Child care resource centers, parenting classes, elder care seminars, resource fairs and support groups are available at several divisions.

Parenting workshops in place at some divisions provide information to employees on managing family subjects that impact their personal lives, such as choosing a quality child care center, managing hyperactive children, and surviving the teen years. The courses are available on-site during lunch hours or after hours.

Work-scheduling issues such as leave policies, part-time work and job sharing also are under consideration along with educational issues such as literacy and English as a second language. ■ Myron Holtzman

Navy honors Electric Boat's better ideas

The Department of Defense recently honored Electric Boat by selecting the division to be the Navy recipient of the department's Honorary Value Engineering Achievement Award as outstanding contractor for 1989. Value engineering awards are given annually by the Department of Defense to a representative from each service.

Value engineering is a cooperative, cost-saving program established between government contractors and government agencies. All of Electric Boat's construction contracts include a voluntary value engineering clause, designed to encourage the division to submit Value Engineering Change Proposals. If accepted, the proposals result in negotiated savings to be shared by the division and the Navy.

"The value engineering program is a win-win situation whereby the government can reduce the cost of the submarines it purchases, while at the same time the company—together with the employees who submit change proposals—can profit monetarily from accepted proposals," said Michael Furgueson, engineering specialist in the division's manufacturing engineering department.

Electric Boat's award was based on two change proposals, both involving the testing of systems aboard Trident submarines. The two saved more than \$3.6 million.

The first proposal covered testing of piping systems. Ship specifications traditionally required that individual piping components, such as valves and gauges, attached to a fresh water distillation plant be tested by using hydrostatic pressure set at a certain percent above the design pressure for each component. The proposal determined that one test pressure could be used for many components, thereby allowing more of them to be tested

at one time and significantly reducing the number and associated costs of individual tests.

The second proposal involved testing strategic weapons systems aboard missile-firing submarines. The Navy has historically conducted simulated missile launches. A number of test launches are made, requiring considerable government-furnished equipment.

Electric Boat determined that the simulated test fell short of proving missile launch reliability. The recommendation was made to reduce—if not eliminate altogether—the number of simulated tests. With the introduction of the D-5 (Trident II) missile aboard USS *Tennessee* (SSBN 734), the usual number of launches was simulated. The number was then dropped to zero for all subsequent Trident II submarines, saving testing costs as well as doing away with maintenance and refurbishing requirements. Further savings are coming from similar reductions on all other existing classes of ballistic missile-firing submarines in overhaul.

■ Graham Gavert

GENERAL DYNAMICS World

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TQM

CASE STUDIES

Land Systems finds statistical processes do office work, too

Land Systems Division is proving that statistical process control techniques work just as effectively in the office as they do in manufacturing. The application of those techniques to total quality management in administrative and technical processes is called

white collar statistical process control.

The techniques are tools that attach analytical significance to areas that are often thought too vague to quantify. Because employees use the techniques, they are more interested in what the statistics say than when management applies the methods.

One Land Systems department that has achieved measurable success in the application of white collar statistical process control is material requirements and finance. This department completes and enters all data into the bill of material.

The bill of material must be 98 percent accurate to ensure the integrity of the manufacturing resource planning system, according to Gail Small, chief-material configuration management. This goal is regularly met, but at the cost of an inspection,

Small added.

"We heard how manufacturing improved quality and reduced reliance on detection methods through statistical process control techniques," Small said. "We wanted to see if it would work for us."

Two department employees, Sharon Cusick and Ed Davidson, were selected to apply the techniques for preparation of the bill of material. They used information gathered from their statistical process control charts to detail the most frequently made errors in preparing the data input form and in loading it into the bill of material.

The results: The accuracy of the bill of material has improved more than 50 percent, and the department is on its way to replacing the inspection with random sample audits.

This success has led other employees in the materials organization to use statistical process control techniques to meet their total quality management objectives in other office functions.

"The important thing to emphasize with employees when starting a white collar statistical process control project is that management is not looking for someone to attribute errors to," Small said. "They are looking for ways to fix problems, usually by increased training or simply making the employee more aware of the effect his work has on others."

■ Karl Oskoian



Ed Davidson and Sharon Cusick review a statistical process control chart.

MILT ST. ONGE

Electric Boat streamlines its production planning

Total quality management is the chance Bob Geary has been looking for.

Geary, Electric Boat Division's vice president-planning and production control, says total quality management represents the opportunity for the division to examine how it gets things done and do whatever it takes to improve them—whether they involve change in process, attitude or organization. "We have to pass along an effective organization to the next generation of managers and employees," Geary says.

Geary's department ensures that design engineers' instructions mesh with shipyard operations by converting designs into work packages to make submarines.

"As we find ourselves in a more competitive environment, we have to question continually how we do business, particularly how we can become more efficient in the construction process," Geary says. "The way you plan the ship and the way you make information and material available to the trade foreman and the tradespeople obviously has a major effect on our ability to get the job done."

Traditionally, most shipyard work has been assigned in work authorizations—long lists of tasks as well as a list of material to complete the jobs. "This level of planning has made it difficult to provide material when it's needed because very often it's not clear exactly when in the work authorization process the specific jobs will be performed," Geary says.

Total quality management offers an improvement to that process. "It's our job to facilitate the transport of data and make it useful," he says. "So we had to take a look at the fundamentals—how do we run our planning and production control business in view of our customers' needs."

"Total quality management is really how you communicate with your internal customers, how you can help make them successful."

Geary says his primary customers are the operations functions at the Groton, Conn., shipyard and the Quonset Point, R.I., facility.

Geary's department formed a team in January with representatives from operations, engineering, quality assurance and finance to better understand their customers' needs.

The impetus behind planning and production control's total quality management effort is the *Seawolf* project. "This is a project where change in the plan-

ning process is being driven by change in the design process—specifically, sectional construction drawings," he says. "We want to be in a competitive position to build future ships. So it really makes sense to do some things differently so that we dispatch only workable assignments through smaller work packages with shorter work schedules."

Before tackling *Seawolf*, Geary's organization embarked on pilot projects to provide training and experience and to demonstrate the value of total quality management. The projects involve short work periods following a submarine's delivery to the Navy, and are similar to warranty work on a car.

The projects replace work authorizations with work packages consisting of complete sets of all the drawings, plans, schedules and materials needed for specific short-term jobs. "We're resolving issues long before they get to the shipyard," Geary says. "That provides the foremen with better tools to dispatch the work and allows the tradespeople to do the job right the first time."

The initial pilot project focused on work packages for the USS *Pasadena* (SSN 752). "We spent more money up front on planning, but the performance of the trades came in ahead of budget," Geary says. "From that perspective, it was a modest success. In terms of a learning experience, though, it was an enormous success."

That experience was put to good use on the second pilot project, the USS *Pennsylvania* (SSBN 735). With the work package approach employed on the entire job, 50 percent more work than originally planned was completed on budget and ahead of schedule, Geary says.

"Things are going well," he says, referring to the work under way on the USS *Topeka* (SSN 754). "There are virtually no material delinquencies and the shipyard is performing

ahead of schedule."

The approach does take some getting used to. "It's a new way of life for the operations people," Geary says. "We're taking away some of their flexibility. It's a much more disciplined environment."

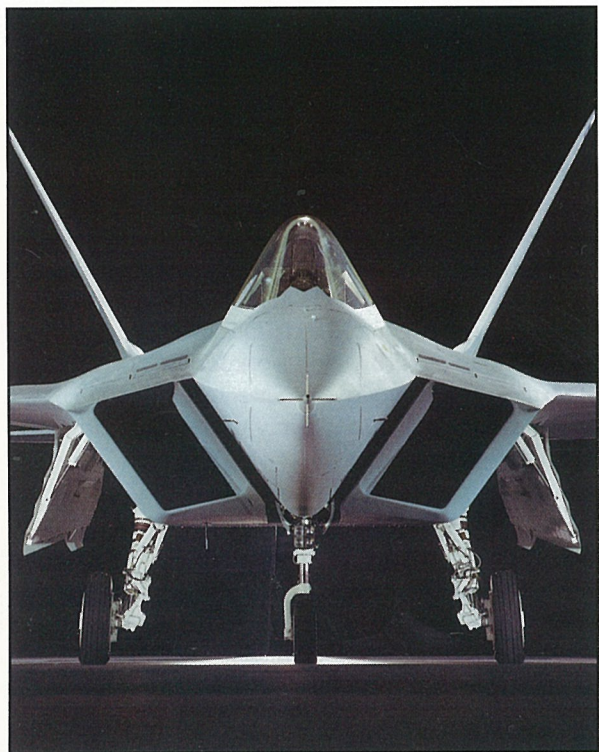
The biggest challenge to making total quality management work is convincing people to change, Geary says. But he says everyone at Electric Boat must recognize that change is continuous, even if it's unwanted. "If we're not willing to question the way we're doing things, we're going to get left behind," he says.

■ Dan Barrett



Total quality management initiatives at Electric Boat Division helped improve post-delivery work performed on USS *Pennsylvania*, sister ship of *Kentucky*, shown at its recent christening.

JOHN VERDUN



A head-on view of the YF-22

LOOKHEED

ATF

(Continued from page 1)

counter the increasing sophistication and threat of hostile air superiority fighters in service around the world. It is to go into operational service early in 2000.

The YF-22's first flight "will occur when it is ready. I think it will be in the very near future," said Brig. Gen. James A. Fain Jr., program director-Advanced Tactical Fighter System Program Office of the Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio.

During a briefing to the news media, Fain said the Advanced Tactical Fighter has been designed to meet "five carefully blended requirements:

- low observable characteristics;
- maneuverability;
- supersonic cruise ability without the need for engine afterburners;
- enhanced payload;
- longer range than the F-15. It will go twice (the distance) that we are getting from today's aircraft."

The new plane will be more survivable, thanks to advanced sensors and low-observable technology.

"These are factors that will give the Advanced Tactical Fighter an edge over traditionally designed fighters," Fain said.

The YF-22 is 64 feet long, has a wingspan of 43 feet and is 17 feet from the ground to the top of its twin fins.

An Air Force fact sheet noted that the plane "will fly and fight in the advanced radar networks and dense surface-to-air missile environments of combat throughout the world. It will use a first-look, first-kill capability to detect and destroy enemy fighters of today—and tomorrow."

The Navy is also participating in the demonstration/validation program to develop a Navy variant that will be called the NATF. It will be capable of being launched from aircraft carriers.

The two services are capitalizing on the resulting opportunities to share design elements where the differing requirements permit. For example, the services are seeking common engines, avionics, materials and subsystems.

The Advanced Tactical Fighter will carry a full complement of medium- and short-range air-to-air armament, including the AIM 120 Advanced Medium Range Air-to-Air Missile and the AIM-9 Sidewinder.

Those weapons will be carried internally and may be launched from revolutionary weapons racks that are hydraulically operated. The aircraft will also be equipped with a proven-design internal gun.

The Fort Worth Division developed and constructed the center fuselage, tail assembly and main landing gear and integrated key systems and armaments. The division is integrating and developing the tailored stores management and inertial navigation systems.

Kentucky

(Continued from page 1)

"Last time I took a look, Kentucky wasn't bottling much champagne," Rep. Larry J. Hopkins, who was the featured speaker at the ceremonies, said. "It only makes sense, while the Trident submarine patrols the world's oceans, bearing the proud name of Kentucky, that Kentucky spirits would bedeck her bow.

"In Kentucky, we like to make our own history and launch our own traditions."

Chairman and Chief Executive Officer Stanley C. Pace, a native of Burkesville, Ky., used the state's proud heritage as an analogy for the Trident submarine.

"Like the state of Kentucky, our Navy's ballistic missile submarines have a proud history and a great future," Pace said. He noted that in more than 2,700 patrols by U.S. ballistic missile submarines, no missile has been fired in anger. "That has to be one of the primary reasons

why we have enjoyed peace for almost half a century.

"History has shown us that no country has ever been attacked because it was too strong."

Added Hopkins: "Modern history has always produced willing and resourceful aggressors against international peace. Today, storm clouds cover the Persian Gulf as a result of Iraq's viciously opportunistic attack against Kuwait. These unfolding events illustrate the constant of human conflict. They testify to the need for us to remain vigilant.

"Our ballistic missile submarines are the foundation for a reduced U.S. strategic force able to provide adequate deterrence...no more, no less than is needed."

The christening ceremony for the Kentucky took place on the deck of the 560-foot, 18,750-ton ship that can carry 24 missiles. Electric Boat is the sole producer of the Trident submarine. ■ Myron Holtzman

Policy for employees called to active duty

General Dynamics has established guidelines for employees called to active military duty in response to the situation in the Middle East:

- The company will compensate these employees for 90 calendar days from the last day worked by paying the difference between his/her military base pay, plus allowances, and the employee's base salary or wages. All payroll deductions in effect will continue.
- All benefits will continue unchanged for 90 calendar days from the last day worked. Further, although the General Dynamics' reservist will be actually employed by the armed forces, coverage under the government benefit plans for dependents of armed forces personnel will be secondary after coverage under the company's plans.
- The following guidelines will apply for any employee continuing active military duty longer than 90 calendar days:
 - Accrued and unused vacation pay as of the expiration of the initial 90 calendar days may be requested and paid in a lump sum.
 - Mortgage interest rate differential payments will cease as of the end of the month following expiration of this transition period of 90 calendar days.

- Payments due the company for computer loans and savings and stock investment plan loans will be suspended during the remaining period of active duty. Payments will begin again after the reservist leaves active military duty.

- The following guidelines will apply after the employees are released from active duty:

- Federal law provides for extensive re-employment rights. The law is complex and the company will comply with it fully. Generally, the company will return the reservist to his or her former position or a position of like seniority, status and pay if the reservist applies for re-employment within 90 calendar days after release from duty, is still qualified, and there has been no change in the company's circumstances that would make reinstatement impossible or unreasonable.
- Upon reinstatement, all service time missed due to call-up to active duty will be credited for all benefits that are service related.

- Due to the fast-changing events in the Middle East, the company will continue to re-evaluate these guidelines for employees who are called to active duty.

GD fights leukemia with volunteers, song

Those who battle against leukemia scored a major victory in August with the aid of General Dynamics.

The company's assistance took the form of employee volunteers, a sizable donation and a specially written song during a telethon shown throughout the nation. The recent event raised \$6.8 million, \$1.7 million more than last year.

Corporate Vice President-Operations Ed Ewing, whose daughter, Erin, has leukemia, served as national chairman for the telethon. Many employees staffed telephones and General Dynamics contributed \$50,000. For example, 12 employees in St. Louis answered telephones. Employees from the San Diego divisions worked telephones at two tables set up outside at Sea World.

Meanwhile, Dennis Lasater, who works in Fort Worth Division's logistics and support department, gave a special donation: a song that he wrote, sang and produced. The song and an accompanying video were widely distributed to promote the goal of finding causes and a cure for leukemia.

The song, titled "We're Closing In," aptly expresses the goal of the telethon in its chorus:

"We're closing in,
For the cure we're coming.
Searching its cause,
We're bringing its end.
We're closing in,
And keeping the promise alive,
One day leukemia will die."

"When leukemia strikes, it steals away what children



TOM HARVEY

Dennis Lasater works at a mixing board in a recording studio.

and young people could otherwise become," Lasater said. "I've tried to stress that everyone must come together to fight the disease."

A children's chorus at Aledo Elementary School near Fort Worth assisted Lasater in singing portions of the song on the video recording.

Lasater was inspired to write the song by his wife, Sharon, who works with professional drag racer Tom "The Mongoose" McEwen. McEwen has been a public figure in the fight against leukemia.

Lasater previously wrote and recorded a theme song, "Ambassadors in Blue," for the Air Force's flight demonstration team, the Thunderbirds.

Col. Henry Crown, 1896-1990

Col. Henry Crown, who died Aug. 14, 1990, may not have been a household name. Yet he was a well-known and self-made giant in the business world—so noted and respected that Howard Hughes once asked him for a loan to keep Hughes' Trans World Airlines operating.

Col. Crown and his family established major holdings in real estate, railroads, airlines, hotels, coal mines, building materials, sugar, meatpacking and major league sports teams. He once owned the world-famous Empire State Building in New York City, which he sold in 1961 when it appeared that a substantial portion of the family's assets might be required to tide a young General Dynamics through one of the most difficult periods in the company's history.

He entered the defense industry in 1959 when he merged his Material Service Corp. with General Dynamics. Largely through his leadership, General Dynamics evolved into a company now employing more than 100,000 people and with sales of \$10 billion.

He lived his entire life in Chicago, where the Crowns give generously to hospitals, schools, museums and primarily to numerous Jewish needs worldwide. He earned the rank of colonel during World War II, when he served as a procurement officer in the U.S. Army Corps of Engineers. He was awarded the Legion of Merit, the Army's highest non-combat award, for his extraordinary service to his country.

Business remained Col. Crown's lifelong pursuit. But he always felt he had made a bad deal if the man on the other side of the transaction didn't become a better friend than before. He became a legend in Chicago business circles and during his lifetime developed a large number of important national business alliances. After being discharged from the Army, Col. Crown became friends with Conrad Hilton and soon was involved in the development of Hilton Hotels.

But accumulation of wealth never was Col. Crown's passion. He distributed most of his sizable fortune into trust funds for his descendants, lived modestly and gave generously to various organizations. He refused to ride in a Rolls Royce once given him for his birthday. In an interview published in 1982, he said: "Money itself isn't the primary factor in what one does. A person does things for the sake of accomplishing something. Money generally follows."

Money certainly did not follow Col. Crown into life. He was born on June 13, 1896, to Lithuanian immigrants. His father, Arie, worked hard to support his wife, Ida, and seven children. The family was so poor that it couldn't afford to give 50 cents to young Henry to buy his eighth-grade graduation photo.

He went to work after eighth grade to help support the family. His oldest brother, Sol, was sales manager at Chicago Firebrick Co. He hired Henry as a shipping clerk, but that first job lasted only two weeks. Sol fired Henry after he sent the wrong materials to a customer.

Soon after, he mounted a letter-writing campaign to 30 or 40 companies that landed him his second job, with the Union Drop Forge Co.'s traffic department in 1911. He took high school business classes at night, and five years later, he and Sol opened a small steel distribution business. That led to the founding of Material Service Corp. in 1919. Sol, Henry and Irving Crown started the business with \$10,000 and bought carloads of sand and gravel for resale to contractors.

Tuberculosis claimed Sol's life in 1921 at age 27. Under Henry's and Irving's leadership, Material Service grew in the 1920s, weathered the Depression, and hit its stride during the post-World War II building boom.

In ensuing years, Col. Crown and his family diversified into many other businesses, but Material Service remained their flagship. He and his sons, Robert and Lester, finally agreed to an offer to merge with General Dynamics.

After months of courting, the two companies joined hands in 1959. Col. Crown intended to serve as a director on the board and not take part in managing General Dynamics. But not long after the merger, the company took a \$433 million loss on its commercial airliner venture, at that time the biggest loss ever incurred by a U.S. company. Col.

Crown quickly took action, persuading the board of directors to close some money-losing operations and restructure management. It was the financial strength of the Crowns' 40-year-old Material Service and the family's assets—including proceeds from the sale of the Empire State Building—that were critical in helping General Dynamics through this tenuous time.

Eventually, differences arose between Col. Crown and the new management, which sought to lessen his influence at General Dynamics. In 1966 the board of directors exercised its right under the merger agreement with Material Service to require that Col. Crown tender his large block of preferred stock to be redeemed for cash, or convert it into common stock. The announced reason for the call of his preferred stock was because General Dynamics was about to be required to pay a 5 percent dividend on the preferred stock after five years during which no dividend was required or paid.

Col. Crown knew that the company did not have adequate financial strength to take on the debt required to redeem his preferred. Therefore, he made an offer so financially advantageous to the company that he felt no responsible management could turn it down. He offered to reduce the dividend drastically on the preferred stock, and to arrange for a large insurance company to lend the money to redeem the stock 2 1/2 years later. In return, he wanted the company to agree not to redeem the preferred stock for the same 2 1/2 years. The Board, at the urging of four of its members and the two senior officers of the company, turned the offer down without ever presenting it to its shareholders or advising them of its existence.

Col. Crown did not convert, but took redemption. The company had to combine loans with money from its working capital to pay him. That contributed to General Dynamics' stock falling in the late 1960s. Subsequently, he bought large blocks of company stock and by the end of 1969, he and his associates

had regained a large interest in General Dynamics for much less money than he had received from the 1966 stock redemption.

He again led the board of directors to restructure management, resulting in the appointment of David S. Lewis as chief executive officer. Working together, the two men charted General Dynamics through 15 years of growth. The period saw the company develop the F-16 Fighting Falcon, a multirole fighter in the air forces of the United States and 15 other nations, as well as an array of other front-line weapon systems for the armed forces. It was during this period, too, that General Dynamics acquired Chrysler Defense Inc., now Land Systems Division, and Cessna Aircraft Co.

Today, Col. Crown's son, Lester, who played a key role during his father's early association with General Dynamics, continues as a member of the General Dynamics board and chairman of the executive committee. Lester's son, James, is also a board member.

"My Dad's extraordinary ability, complete unselfishness and contributions to so many facets of our world have been overshadowed only by his remarkable humility," Lester said.

"The proclamation given to him in 1986 upon his retirement at age 89 from General Dynamics' Board of Directors summed it up very well. His fellow directors paid a most fitting tribute to him with these words:

'He has given generously to others, but sought no honors or personal recognition in return. His friendship, once attained, is bonded with loyalty and trust while his modesty and quiet dignity are an inspiration to all who have had the uncommon privilege of working with him and who revere him. Compassionate and forgiving, he also required that those around him strive for the highest standards of ethical conduct. This is Henry Crown's legacy to General Dynamics.'"



(From left) Col. Henry Crown, then-Chief Executive Officer David S. Lewis and Lester Crown in January 1981.



Col. Henry Crown holds a model of an F-16 Fighting Falcon at the Paris Air Show in 1981.

First two Abrams to a foreign nation go to Egyptians

The first two Abrams tanks sold to a foreign nation were recently turned over to Egyptian officials in ceremonies at the Lima (Ohio) Army Tank Plant.

Representatives of Land Systems Division and the United Auto Workers presented the tanks to Lt. Col. Raymond Pawlicki, U.S. Army commander at the Lima plant. Pawlicki then handed over the tanks to Maj. Gen. Mohamed M. Sallam, Egyptian tank plant vice chairman and general director.

The two tanks were delivered a month ahead of schedule so they can appear in an Egyptian exposition later this year. They are the first of 555 tanks going to Egypt. Land Systems will complete 15 and send the remainder in kits for assembly by the Egyptians at a plant under construction. The Egyptians will use the 15 completed tanks for operational and assembly training.

The sand-colored tanks constitute the first in what Land Systems hopes will be many sales of the Abrams to foreign governments. The United States and Saudi Arabia recently signed an agreement for the purchase of 315 fully assembled M1A2 tanks. The United Kingdom, United Arab Emirates, Sweden, Pakistan and Canada have shown interest in the Abrams.

"These two tanks represent only the beginning of a joint venture between General Dynamics and our friends from Egypt," said Richard O. Gillette, Land Systems manager at the Lima plant. "This partnership and other new contracts will help keep our work force building the best main battle tank in the world."

Sallam cited Egypt's enthusiasm over receiving the tanks. "There was a lot of discussion and arguments on what would be the tank of the future for the Egyptian army," he said. "I am very proud because this is the tank I chose."

■ Karl Oskoian

Cessna to repeat Special Olympics airlift of athletes

About 1,500 athletes and their coaches will be airlifted to the International Summer Special Olympics Games in Minneapolis/St. Paul July 19-27 in a fleet of some 200 Cessna Citation business jets.

More than 60 companies have already agreed to provide Citation jets for the airlift, said Cessna Chairman Russ Meyer.

Special Olympics is the world's largest organization of year-round sports training and athletic competition for children and adults with mental retardation.

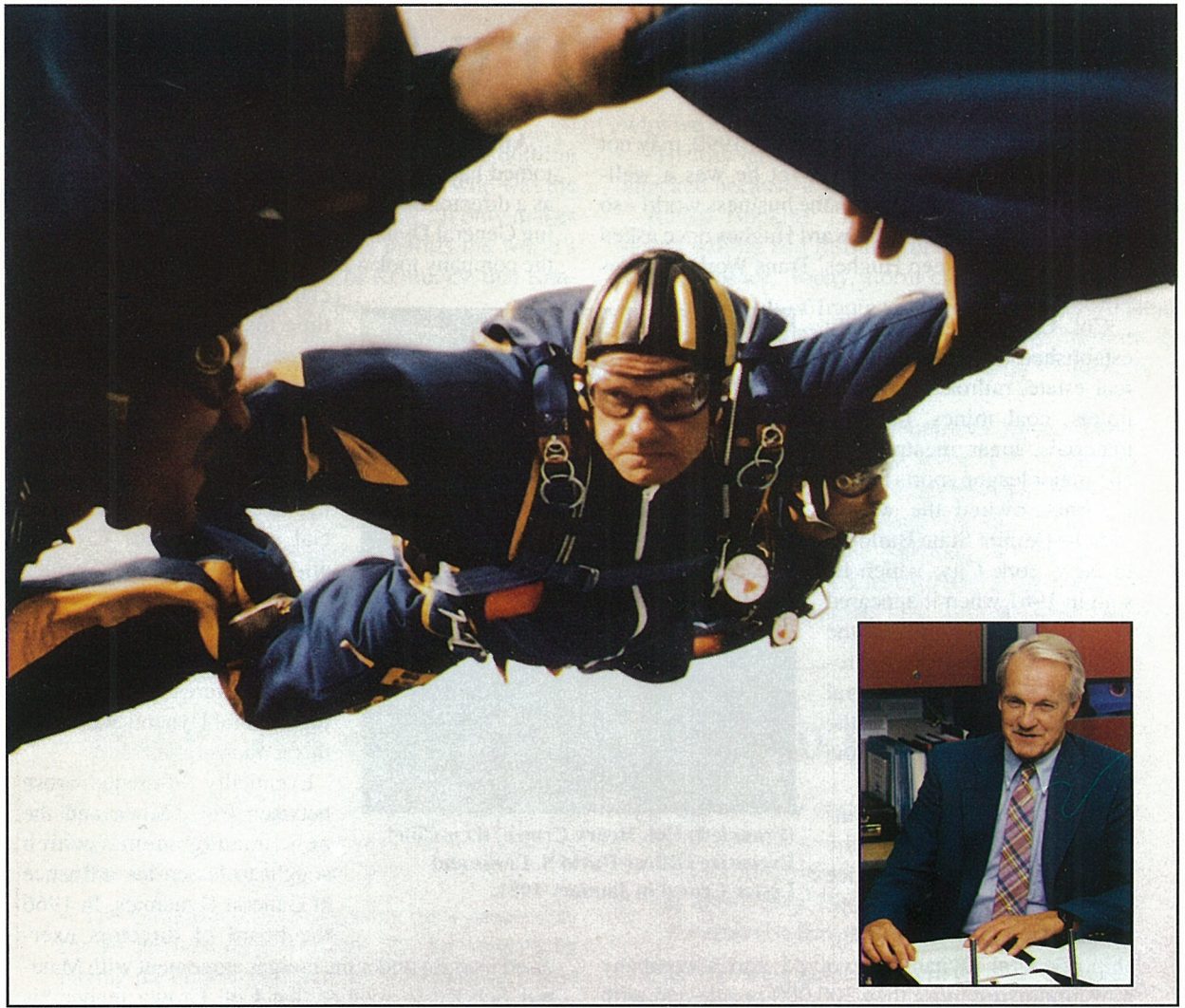
It will be the second Citation Special Olympics Airlift organized by Cessna. In 1987, Cessna's customers donated 132 Citations and their flight crews to carry nearly 1,000 athletes to the International Summer Special Olympics Games in South Bend, Ind.

Planning for the 1991 airlift began more than a year ago and was prompted by Cessna's positive experience in 1987. "As we stood on the ramp and watched the last Citation lift off the runway, we all knew that we had to do it again in 1991," Meyer said.

"Cessna keeps Special Olympics flying high," said Sargent Shriver, Special Olympics International chairman. "Without Cessna's help, we would be confronted by an overwhelming transportation challenge."

Cessna officials are optimistic some 200 companies from more than 30 states will participate in the airlift. It will originate from 20 to 25 cities in 15 to 20 states, within approximately two hours flight time or up to 1,200 miles from Minneapolis/St. Paul. Each plane will carry six to eight athletes. Arriving aircraft will land every two to three minutes over an eight-hour period.

More than 6,000 athletes from nearly 90 countries will participate. Competition will be held in aquatics, track and field, basketball, equestrian events, soccer and gymnastics.



Norm Olson pursuing his passion for parachuting and (inset) in his Electric Boat office

Electric Boat's Olson jumps for joy

Jumping out of an airplane wouldn't seem to represent a triumph of reason. But to Norm Olson, skydiving is the ultimate reflection of rational thinking, of mind over matter—the matter being the possibility of meeting Mother Earth at 120 mph.

Olson, director of security at Electric Boat Division, knows about positive thinking. Over the last 34 years, he's made more than 2,300 parachute jumps. In each of those jumps, he says, he's used reason to control his emotions. "When you jump, you have to use your mind to overcome panic and fear," he says.

Olson's introduction to parachuting came in 1956 when, as a member of a Navy Underwater Demolition Team, he investigated dropping into objectives. While leading the first Navy group through the Army's Fort Benning parachute-training school, he became hooked.

"For your first jump, the instructors get you so hyped up that you're going to do it, no matter what," Olson says. Then reality sets in. "For the next 50 or so jumps, there's stark terror that you have to overcome," he says. "After that, you begin to feel quasi-comfortable."

Olson made his first free-fall jump in 1959, enjoying it so much that he went on to what's known as HALO (high altitude, low opening) parachuting. That's where you jump at 30,000 feet, enjoy the view as you drop like a stone, then pull the ripcord at 2,000 feet and hope for the best.

A few years later, Olson formed the Navy's first parachute demonstration team, both as a way to improve public relations and build a solid nucleus of seasoned jumpers for the Underwater Demolition Teams. Many of the techniques developed for the team's performances

were later integrated into Underwater Demolition Team parachuting. Olson, who retired from the Navy as a captain in 1983, spent most of his 30-year career with the Navy's elite Sea, Air, Land (SEAL) teams.

"To a layman, every jump seems dangerous," Olson says. "And I'm not suggesting it's not. But if you're properly trained and you use your head, things should be OK. Periodically, people do get killed or hurt."

The biggest danger to parachutists comes from equipment failure. In Olson's case, there have been a few such failures—instances when his parachute failed to fully deploy. He was able to successfully open his reserve chute, however, and descend safely.

"I've had three of those, but whether they could be characterized as dangerous, I don't know," Olson says. "I managed to come out of them in one piece."

There has been, nonetheless, the occasional trip to the hospital. "I've busted an ankle, busted a leg, broken a wrist, dislocated a shoulder real bad and dislocated an elbow real bad," he says. "Most of those injuries were my fault."

"This is a sport where you sometimes get overconfident. When you do get too cocky, you'll get knocked right back on your heels."

Despite that and the considerable expense, Olson remains completely absorbed. "It's hard to explain... it's almost addicting," he says. "Once you go out of the plane, you're right on the edge and you have to do things right. You're doing a lot of things in those 60 or so seconds, and there's a lot of pressure. But it's tremendously exhilarating. You just get to love it."

■ Dan Barrett

Team huddles on game plan for X-30

Members of the contractor team formed to develop the National Aero-Space Plane have begun meetings at a temporary program office in Seal Beach, Calif. Armand J. Chaput, Fort Worth Division's director for the program, is serving as the team's interim chief engineer.

The U.S. government recently approved formation of a national team including General Dynamics, McDonnell Douglas, Rockwell, Rocketdyne and Pratt & Whitney to complete the technology development phase of the plane.

The program's long-range goal is development and flight testing of a hypersonic, single-stage-to-orbit research vehicle designated the X-30.

The team has been meeting to share data on work the

individual companies accomplished as competitors. A new baseline X-30 configuration, incorporating the best features from all the individual concepts, will result in 1991.

Barry Waldman, program director for the contractor team, explained aspects of the teaming agreement at a recent technical conference. Waldman, a Rockwell executive, was chosen to lead the team by consensus of the companies.

The teaming agreement is unprecedented in American industry, according to Waldman. "We've never had a situation of five companies working together with the government to develop a radical new technology," he said.

■ Joe Stout

Reactor Plant Services keeps radiation problems under control

The Department of Energy found itself in a predicament last year. Its Rocky Flats, Colo., plant was undergoing environmental cleanup and needed a firm to help control radiation.

No problem. The department simply called Reactor Plant Services, an operation organized under General Dynamics Services Co.

Rocky Flats required a specialized enclosure, the kind manufactured by Reactor Plant Services. The company constructed two Perma-Con™ modular containment systems—actually minibuildings—around radioactive material inside the Rocky Flats structure. The material was then safely decontaminated without radiation exposure to people and things outside the Perma-Con™ enclosure.

"The contracting officer for the Department of Energy was amazed," said Don Pratt, Reactor Plant Services manager-administration. "He told me, 'I gave you an impossible task. But the equipment was delivered ahead of schedule and within specifications. It's refreshing to do business with a company where the customer's needs come first.'"

Reactor Plant Services was founded a dozen years ago within Electric Boat Division to provide the commercial nuclear power industry with radiological control services and products. Located in Mystic, Conn., the firm was staffed with senior radiological control managers, engineers and health physics specialists experienced in all aspects of radiological engineering and health physics. The array of expertise guaranteed that the company could respond promptly to the needs of the commercial nuclear power industry.

It didn't take long for the industry to call on the company. After an accident at the Three Mile Island facility in 1979, five members of the Reactor Plant Services team provided support to the facility's radiological control organization. The team helped stabilize conditions on- and off-site.

Personnel were assigned to Three Mile Island for 30 months. They helped with water treatment systems, auxiliary building decontamination, entry into the containment building and development of a radiological control procedure.

Reactor Plant Services has since broadened its range of products and services. "We recently expanded our product lines to assist in decontamination and decommissioning activities at commercial and government sites that are to be shut down or converted to fossil fuel," said Paul Clark, director-Reactor Plant Services.

The Perma-Con™ modular containment systems used at Rocky Flats represent the largest hardware sold by Reactor Plant Services, which deals with commercial as well as government reactor units. Many Perma-Con™ systems are used at nuclear power stations. "The systems were originally developed for the commercial market," Pratt said. "But now we're finding it has a lot of appeal for the Department of Energy and industrial hygiene markets."

The stainless steel enclosures are easy to put up, decontaminate, take apart and move. Reactor Plant Services also sells a portable ventilation system, heat-stress control products such as air-cooled suits and climate control rooms, post-accident reactor coolant and containment air sampling systems, and decontamination systems for respirators, laundry and equipment.

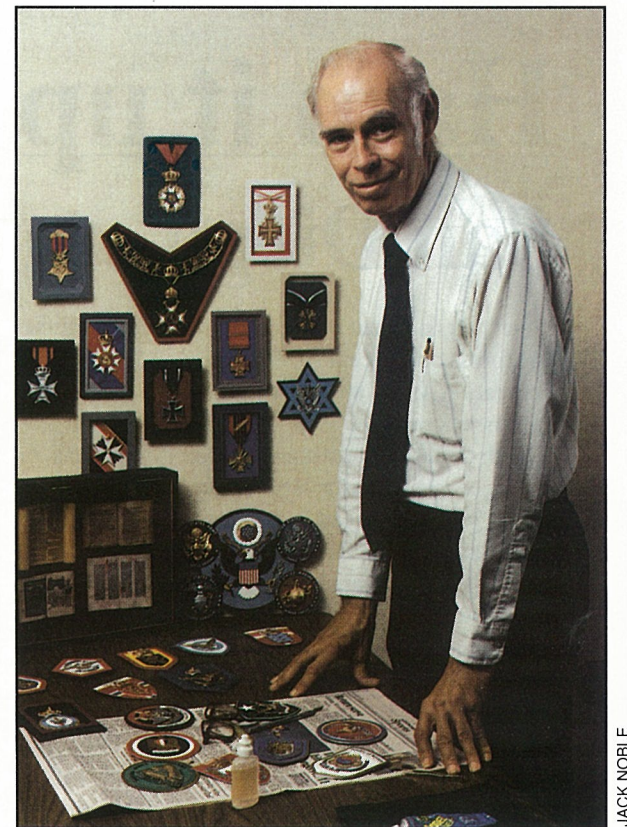
Reactor Plant Services still has access to engineers at Electric Boat and several other divisions. "The fact that we do have the experience and expertise of the whole corporation behind us has become our competitive edge," Pratt said.

Clark became director of Reactor Plant Services in May after serving as General Dynamics Services Co.'s director-operations for the Domestic Operations unit. He sees continual growth for Reactor Plant Services.

"We're selling systems to public utilities, power plants and the Department of Energy—anyone who has radioactive materials," he said. "We're expanding. Our plans are to continue to meet the growing needs of the nuclear industry."

"Our expansion into decontamination and decommissioning activities will enlarge the business base at Reactor Plant Services and provide longer-term contracts."

■ Myron Holtzman



Wayne Kinney displays medals, emblems and biblical texts he has reproduced.

JACK NOBLE

Kinney makes keepsakes from paper, glue, paint

Fort Worth Division's Wayne Kinney combined his artistic skills, interest in history and pride in the multinational F-16 program to create an unusual hobby.

Kinney uses a knife, stylus, paper, glue and paint to reproduce authentic military medals and national emblems. He sometimes goes to his closet and selects an old necktie to supply the material if a particular medal requires a red or blue ribbon.

The result is an impressive, rich-looking adornment—it could almost be an heirloom—for a modest investment in materials and time.

Kinney said time is no problem because he makes most of the pieces at home while listening to or watching Texas Rangers baseball games. In fact, he started his hobby about the time the 1989 baseball season began.

"I hate just sitting and don't like to be totally idle," he said. "This gives me something to do while I follow the games."

The 33-year General Dynamics employee said the process of making a medal always starts with research. "It all relates to heraldry," he said. "I began by making the flag emblems of the countries that have purchased the F-16."

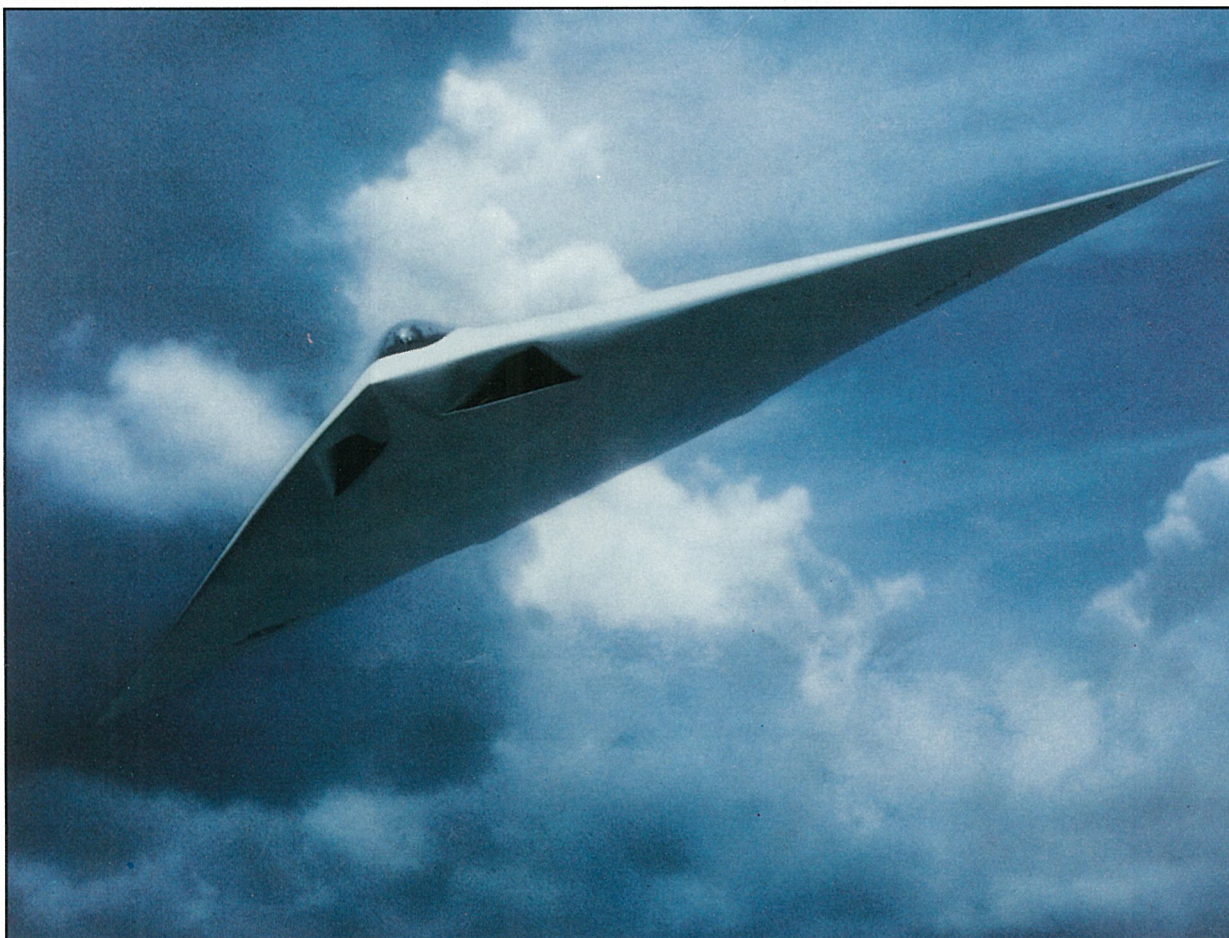
Kinney has created replicas of Great Britain's Victoria Cross and French Legion of Honor Medal, among others, in addition to emblems of the 16 nations that fly the Fighting Falcon.

Many Fort Worth employees are aware of his hobby because nearly 30 of the replicas are displayed in the graphics department, where Kinney works as an illustrator. He has given a number of the pieces to friends and co-workers, but never sells them.

He has also made objects such as a miniature Dead Sea Scroll replica and a series of miniature Bibles, from Latin and Greek to Gutenberg, that symbolize the evolution of the book.

Another project—one of his favorites—was a relief of the Texas Rangers' logo and a baseball.

■ Joe Stout



U.S. NAVY

First glimpse of A-12. This artist's concept was recently released by the Navy and offers the first look at the A-12 Avenger, the plane being jointly developed by General Dynamics and McDonnell Douglas. The carrier-based, all-weather attack aircraft will carry a pilot and a bombardier. The A-12 is expected to have double the reliability while needing only half the maintenance hours and fewer spare parts than the aircraft it replaces. The Navy plans to buy 620 Avengers. Rollout is expected in late 1991.

Savings and stock investment plans

Annual rate of return for the 12-month period ending:

	July 1988	July 1989	July 1990
Salaried			
Government bonds	7.2%	9.6%	8.2%
Diversified portfolio	(11.0)%	31.5%	5.2%
Fixed income	10.9%	10.4%	10.1%
Hourly			
Government bonds	7.4%	9.7%	8.2%
Diversified portfolio	(11.4)%	32.3%	5.3%
Fixed income	10.9%	10.4%	10.2%
GD stock closing price	\$52.87	\$58.37	\$26.75
() Denotes negative number			

Ham it up

San Diego employees help during emergencies

If the "big one" had set the earth shaking in Southern California on a recent summer weekend, the Convair Recreation Association's Amateur Radio Club would have been ready.

With portable generators, temporary antennas, mobile equipment and a large quantity of coffee, the "hams" were deployed in the Convair Recreation Association's Missile Park for their annual field day exercise. They operated for 24 hours straight under simulated disaster conditions.

Through San Diego's disaster preparedness office, the Amateur Radio Relay League has designated Convair's club the primary amateur radio communications center in the city. The club has a large membership and extensive facilities, acquired with the support of the Convair Recreation Association.

"Our station at the CRA clubhouse is designed to be independent of the main power supply to the plant in an emergency," said Nick Callas (call sign K6DBJ), Convair retiree and station operator. "If the building is still standing, we can operate effectively during a disaster for what we call health and welfare traffic."

Ham radio operators have always played an important, if unofficial, role during disasters. "During last year's San Francisco quake, hams were on the air long before the major communications systems came back on," said Harvey Hiller (KD6QK), a senior material analyst at Data Systems Division Western

Center and club officer. Indeed, Callas spent most of the night on the radio with a ham in the San Francisco Bay area channeling calls to the man's still-operating telephone.

The club would operate in coordination with the San Diego divisions' disaster preparedness plans if a disaster happened during regular working hours. Otherwise, members would be dispatched to designated spots under the control of the Amateur Radio Emergency Service. These locations would include police stations, hospitals, fire stations and various recreational centers.

For field day, the club began setting up early in the morning so they could go on the air at 11 a.m. Members erected two mast antennas, a beam antenna and two shelters housing the equipment to protect the operators from the afternoon sun and the cool nighttime breezes.

Club members took turns sending and receiving messages in both code and voice, carefully logging each completed message on large spread sheets during the next 24 hours. Field day is actually a contest to see how many points a club can accrue—two points for a Morse code message, one point for microphone, 100 points if a specific message from the Amateur Radio Relay League is copied and 100 points for successfully sending a message to the league's section communications manager.

"C-Q-Contest, C-Q-Contest," Jack Hilton (KI6AR)

intoned into the microphone in the voice tent. "This is W-6-United-United-Sierra calling 2-alpha-San Diego." Hilton was announcing the club's call sign—W6UUS—and indicating that they were transmitting from San Diego with two stations under emergency power.

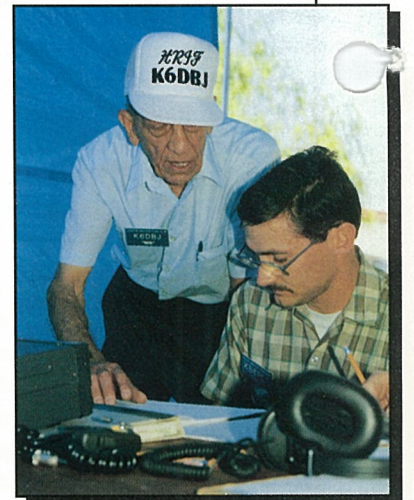
Over the next 24 hours, club members logged 296 messages by voice and 52 messages by code from most of the states and several Canadian provinces.

Convair Recreation Association hams also provide support for other community events such as walkathons and distance running events. Some hams patrol the San Diego County back country to support the Department of Forestry during the fire danger season in Southern California. Fund-raising events provide the money to buy the right kinds of antennas for hospitals and fire and police stations so they will be suitably equipped for amateur radio support.

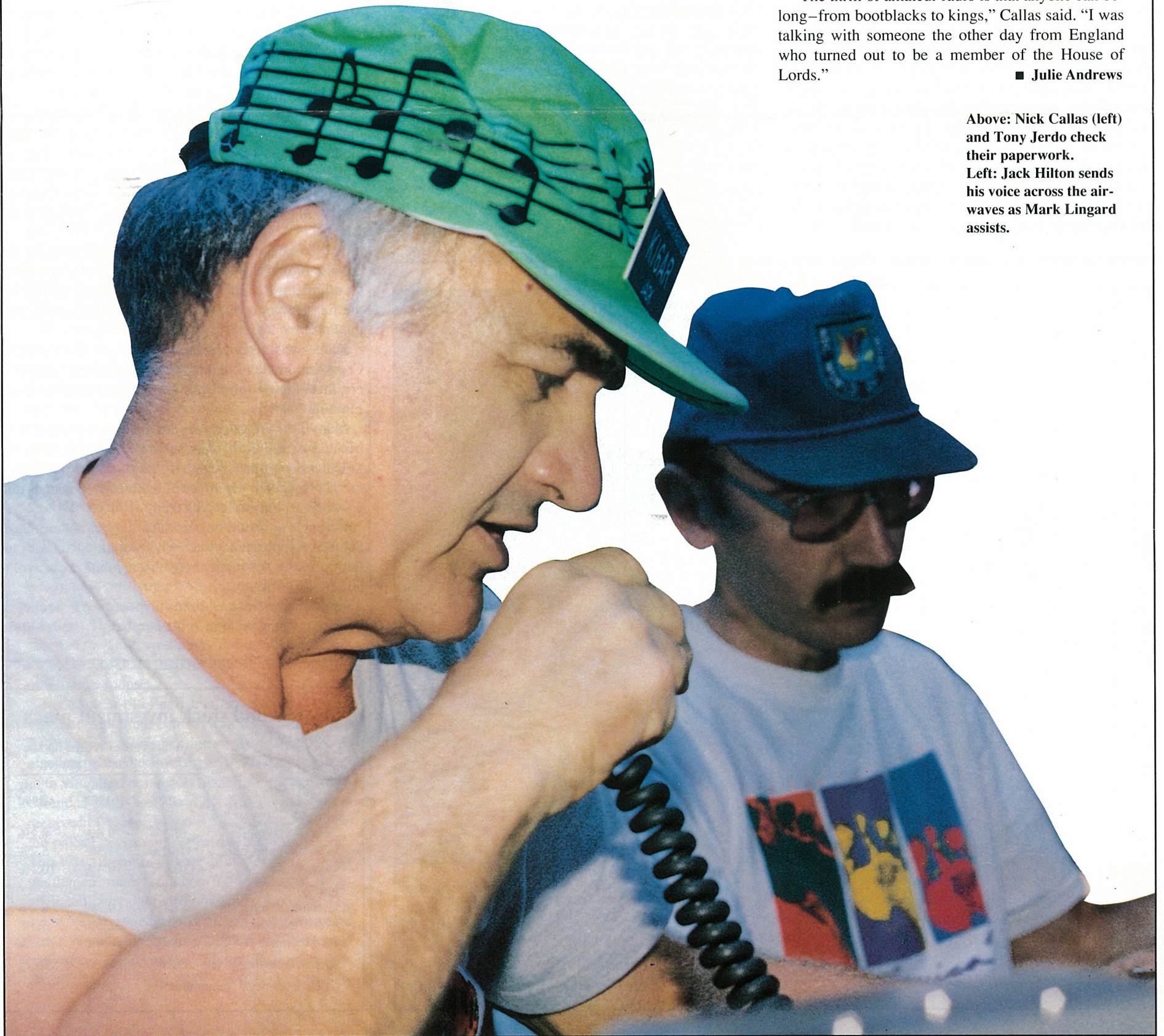
But the heart of the hobby is still the enjoyment of talking with someone who may be half a world away.

"The thrill of amateur radio is that anyone can belong—from bootblacks to kings," Callas said. "I was talking with someone the other day from England who turned out to be a member of the House of Lords."

■ Julie Andrews



Above: Nick Callas (left) and Tony Jerdo check their paperwork.
Left: Jack Hilton sends his voice across the airwaves as Mark Lingard assists.



GENERAL DYNAMICS

World

Volume 20 Number 10

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ATF airborne. The YF-22 Advanced Tactical Fighter takes off (top) and lands on its first flight. The aircraft, built by Lockheed, General Dynamics and Boeing, took to the air for the first time Sept. 29.

Company mourns death of Mullins

William H.L. "Moon" Mullins, General Dynamics' corporate vice president-government relations, died Sept. 29, 1990, in a plane crash in Chatham, Mass. Mullins, 55, directed the company's operations in Washington, D.C., from General Dynamics' office in Arlington, Va.

"Moon will be greatly missed by us all and by his many friends in Washington and elsewhere," said Chairman and Chief Executive Officer Stanley C. Pace. "He was a good friend, a good husband and father and a great patriot. He excelled in maintaining General Dynamics' important relationships with its customers and with the government. Those of us who were fortunate enough to have known Moon extend our deepest sympathies to his family."

Vice Chairman Bill Anders, speaking at an all-hands meeting of Washington Office personnel Oct. 1, called Mullins' death "not only a personal loss, but a profes-

'Moon' remembered...page 2

sional tragedy for the company. Moon played a key role in leading Washington Office activities, which are of such vital importance to the corporation. All of us are shocked, saddened and crushed by the news of his death."

Mullins joined General Dynamics in July 1979 after retiring from the Air Force as a highly decorated brigadier general. During a 22-year career, he received the Bronze Star, the Distinguished Flying Cross with four oak leaf clusters and the Air Medal with 12 oak leaf clusters. Mullins flew 146 combat missions as a fighter pilot during the Vietnam War. He served as deputy director-legislative liaison during his last two years in the Air Force.

He is survived by his wife, the former Florine Mag-nani, and two sons, Dan and Todd. A native of Independence, Mo., Mullins graduated from the U.S. Military Academy in 1957 and received a master's degree in business administration from the University of Arizona in 1967.

GD's goal is 'enhanced shareholder value,' Mellor says

General Dynamics recently completed its executive office management transition with the election of Jim Mellor as president and chief operating officer. He will begin his new job on Jan. 1, the same day that Bill Anders becomes chairman and chief executive officer.

Mellor succeeds Herb Rogers, who will continue on special assignment as general manager at Fort Worth Division. Rogers will become vice chairman on Jan. 1. Anders takes over from Stan Pace, who is retiring.

This month marks Mellor's ninth anniversary with the company. Mellor has been executive vice president-marine, land systems and international since July 1986 and has been on the board of directors since joining General Dynamics.

Mellor holds bachelor's and master's degrees in electrical engineering, has authored more than 30 published papers and has been issued three patents. He and his wife, Suzanne, have three married children and seven grandchildren. Mellor plays tennis and "is trying to get back into golf after almost 30 years, but I've only gotten out three times this year," he said.

He recently discussed some of his and top management's views of the company and the industry.

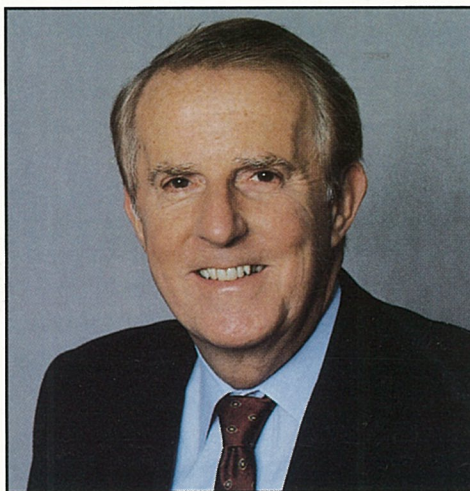
Q What will be management's No. 1 long-term objective?

A Enhanced shareholder value. This doesn't mean less emphasis on such areas as customer satisfaction, which is integral to all of our future business thrusts; engineering excellence, which will remain a key to the programs of tomorrow; or the ethics program, where great strides have been made over the last few years. But these all have to be considered as means to an end—increased value for all of our shareholders.

To reach that goal, Bill Anders and I, along with the entire management team, will look for quantum improvements in efficiency and productivity. Doing well what we did in the past will not be enough. All of us will have to adapt to cultural and structural changes that al-

low us to move faster to our goals. We will have to eliminate, or at least reduce, red tape. We will have to operate as a team. Communications will have to be simplified. Most importantly, we need to focus on the payoff that these actions will bring.

We will achieve this, at least in part, through delegation. Bill and I are real proponents of delegation—down to the level where the right people are making the decisions. But with responsibility goes accountability. So



Jim Mellor

you will see more and more emphasis on responsibility, authority and, with that, **accountability**.

Q With the contraction in the defense budget, what are management's near-term priorities?

A Downsizing is absolutely essential if the future viability of this company is to be assured. The defense budget is projected to fall 2-5 percent a year, and there is no reason to assume that we are going to be immune to the budget decline's impacts.

We can't afford to let the budget decline get ahead of us. We must have downsizing in our overhead, facilities,

organizational structure, etc., in place so we can respond as the government buys less of our bread-and-butter products such as submarines, aircraft, cruise missiles and tanks.

One of my main jobs, with a lot of help from our line and staff organizations, is to downsize **intelligently**. We will have to cut the work load, not just the work force. We will review staff and line functions to see if there is value added in every case. If not, we will reduce, redirect, restructure or eliminate. We want to start working **smarter**, not harder. We will cut the fat but we have to retain the muscle so that when the resizing of our company is complete, we will be not just leaner but stronger.

We will be a vigorous, well-run leader in our industry, one highly regarded for its high ethical standards, its technological expertise, its skill in designing and building complex systems. And we will be an outstanding place for our employees to work. To my mind, the company's people are our most important resource.

Q How does downsizing fit in with the company's long-term objective of enhancing shareholder value?

A There's a direct link. If we successfully improve our near-term performance, we reap two benefits that support our long-term objective.

First, we increase the internal resources that can be invested in long-term business activities that will further enhance shareholder value. Second, we reinforce our credibility with our key customers and the investment community. Improved near-term performance boosts their confidence in our ability to sustain consistent long-term performance, with the result that they will be more inclined to maintain business relationships with General Dynamics. (Continued on page 2)

People, products participate in
Desert Shield—pages 4, 5

Current & Comment

'Moon' remembered

Rep. Silvio O. Conte of Massachusetts paid tribute to William H.L. "Moon" Mullins in the following address to the House of Representatives Oct. 1. Mullins, General Dynamics corporate vice president-government relations, died in a plane crash Sept. 29.

Mr. Speaker, it is a most painful task to pass on the news of the death of retired Brig. Gen. W.H.L. "Moon" Mullins. Moon was a close friend and great pal to so many in this body.

He was killed in a crash on Saturday during aerobatics in a restored World War II P-51 near the Chatham, Mass., Airport on Cape Cod.

I suppose if Moon had to choose a way to go, this would be it. He was a true fighter pilot in every respect and his love of flying was a paramount part of his life even in retirement.

He was a highly decorated pilot who flew 146 combat missions in the Vietnam theater. Then he came back to head the Air Force congressional liaison in the House where his straight talk and warm personality won the respect of everyone.

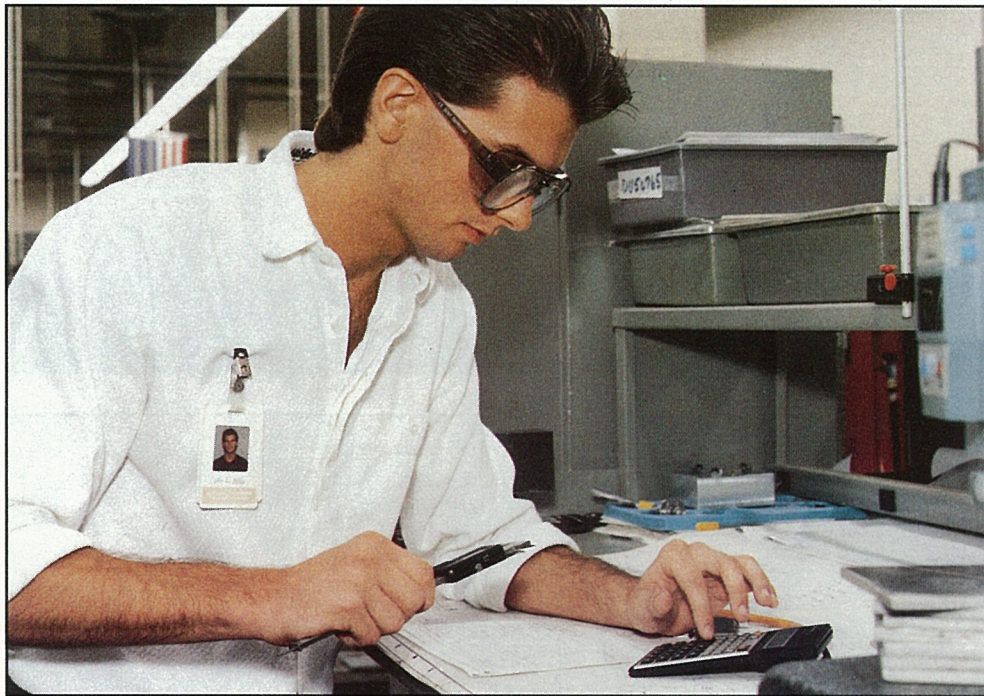
He was the first to make the rank of general in his West Point class of 1957 and the youngest general in the Air Force at that time. But that was to be expected.

He was tops in his class, captain and all-American selectee in lacrosse and head of the Glee Club. Nothing meant more to him than the military life and the Air Force except his family. He married the beautiful and charming Florine Magnani and they have two boys, Todd, who works in Senate Veterans' Affairs, and Dan, who just graduated from the Air Force Academy and is now a second lieutenant in flight training.

He chose to retire early from the Air Force in 1979 even though he was described as having a brilliant career ahead of him. He simply wanted to spend more time with the family. Since that time he has headed the government and congressional affairs office at General Dynamics.

Moon was more than the all-American boy, he was a tough leader with a sense of caring for the nation and a hearty concern for each of his fellows. God endowed Moon with the finest Irish tenor voice on either side of the ocean. He kept that voice vibrant at dedications, and at passings. Whether it was at the bedside of Pete Murphy, our since-departed Defense Appropriations Subcommittee director, or at the funeral of Gen. "Maggie" Maglione, the sweet, clear lilt of his gorgeous voice brought tears down every cheek.

Mr. Speaker, if we listen carefully now we can hear his haunting, beautiful version of "Danny Boy" telling us that the "pipes, the pipes are calling" Moon Mullins home. Former Speaker "Tip" O'Neill loved Moon like one of his family. We all loved him like a brother. So to Flo and the boys we offer our deepest sympathy on his passing and thank them from the bottom of our hearts for sharing that man among men with us for all these years.



Jay Moss calculates data for his machining work at Air Defense Systems.

BERT ASA

Let the games begin: Machinist finds place in International Skill Olympics

Jay Moss is in the Olympics.

The machinist at Air Defense Systems Division recently qualified for the U.S. team that will compete in the International Youth Skill Olympics in Amsterdam, the Netherlands, next June. Moss made the team by winning the machining competition at the U.S. trials in Chicago.

Moss attributed his success to the many division employees who tutored him and strongly emphasized accuracy in part-making. Moss is training for the international event at the Air Defense Systems' Rancho Cucamonga Facility.

Another division machinist, Frank Konz, finished fourth in the turning category at the trials. Moss and Konz earned a trip to the trials with their performances at the U.S. Skill Olympics, sponsored by the Vocational Industrial Clubs of America. Moss finished first and Konz second in their events. They also won top honors at regional and state events.

A third division employee, Jacob Christ, placed first in

the post-secondary electronics technology category at the U.S. Skill Olympics. But the electronics calibration technician did not earn enough points to qualify for the U.S. team trials.

"It is an honor, not only for them, but for all of us, that they have reached such a high level of VICA participation," said Len Stuessel, Air Defense Systems vice president-production and recently elected chairman of the California Vocational Industrial Clubs of America Youth Leadership Foundation. "They are representative of the many skilled employees here."

Moss and Konz are graduates of Fontana (Calif.) High School and are attending San Bernardino Valley College. Christ graduated from Pomona (Calif.) High School and is attending Mt. San Antonio College. Christ is majoring in electronics technology. Moss wants to be a manufacturing engineer. Konz would like to become a mechanical engineer.

■ Jerry Littman

Mellor

(Continued from page 1)

Q Besides the falling defense budget, what are some of the problems the company faces?

A The government's business policies and contractual terms and conditions are major problems. Such things as fixed price development, low progress payment rates, dual-source contracting and changes to the means of taxing profits of long-term contracts have impacted company performance.

Stan Pace, through his leadership with organizations such as the Aerospace Industries Association, has been an outspoken advocate for changes in these areas. We need to capitalize on the groundwork that Stan has laid and, whenever possible, accelerate these changes. The key people in Washington are increasingly understanding the effect this has had on our business. The company, through Bill Anders, will continue to take actions against these problems to strengthen our performance.

Q What are some of the bright spots in the years ahead?

A While I have stressed the absolute necessity for some dramatic changes in our company over the next few years, there are a number of bright spots that provide a lot of hope for the future. First, there is outstanding technological capability throughout the company with world-class skills in areas such as composites, artificial intelligence, signal processing, systems integration and fluid dynamics. Second, we've built a sales backlog in excess of \$25 billion. Third, we have an intelligent and highly committed work force ready and capable to meet the challenges we face.

Q Any thoughts about diversification?

A I don't see anything in the near term. We investigated commercial diversification several years ago. The

success rate of others who had embarked on this trail—such as McDonnell Douglas, Lockheed, Northrop and Boeing—was less than 20 percent. People do best what they are trained for—in our case, designing, developing and building weapon systems. Contracting with the government is dramatically different from the commercial arena. For these reasons, we decided to stick with defense. However, Bill Anders does not have a closed mind to any new directions. If the shareholders can be well-served, diversification should at least be considered—especially if we have some familiarity with the field.

Q What is your management philosophy?

A My style focuses less on management and more on **leadership**. Stan Pace and Herb Rogers have put together an excellent team. With Bill Anders taking the helm in January, I see this organization focusing on a team approach to meeting our objectives. Bill will determine the future vision of the company in consonance with this management team. And we have been working on this for several months in what we call "The Decade of the '90s" meetings.

My role will be to communicate this vision to key team leaders in the form of objectives that support our goals. I will provide the team with broad direction that capitalizes on each person's leadership skills. The team will periodically measure our progress against our objectives and adjust as necessary.

Neither Bill Anders nor I can achieve this on our own. We have a talented and motivated team, which we will rely on to move the company ahead. I'm looking forward to releasing this energy and talent on our challenges. I'm sure the results will be impressive to our customers, our employees and our shareholders.

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Diversity program offers child, elder care assistance

(This is the second in a series about General Dynamics' employee diversity program.)

Finding summer care for her 11-year-old son challenged Kathy Chin, a single parent.

"Since he has been in some kind of day care most of his life, I was looking for a care program that was unique," said Chin, a human resources supervisor at Convair Division. "During the school year, he stays extended hours at school in study hall or organized activities. He goes to day camps during the summer months. It was a real challenge getting both of us ready and out the door on time in the morning."

That routine changed dramatically this summer. Several San Diego divisions initiated a summer camp at the Kearny Mesa facilities' Missile Park as part of General Dynamics' employee diversity program. Employees could drop their children off in the morning and pick them up after work.

The camp, started in conjunction with the YMCA, offered various activities, including swimming, horseback riding and field trips.

"I can't tell you what the camp meant to me," Chin said. "Not only was it the convenience of not having to go out of the way to take him to a day-care facility, but he was excited to be spending the day where I spend my day. He was anxious to get ready in the morning."

"Also, we were spending so little time together that this was an opportunity for us to share more time together. I was even able to pack a lunch and go over to Missile Park several times and eat with him. We both enjoyed the time together."

Elaine Horak, a human resources representative at Convair, agreed. She and her husband work. They decided to send two of their children to the camp.

"They were bored," she said. "They were just sitting around watching television or playing Nintendo. When we told them about the summer camp, they jumped at the chance. They liked the idea of riding in with mom every day and seeing where I worked. And they loved the camp. It was the highlight of their summer."

Child-care facilities have become an important part of

"(The children) loved the camp. It was the highlight of their summer."

— Elaine Horak

General Dynamics' diversity effort because of double-career and one-parent families, according to Anne Serra, corporate manager-human resources special projects, the leader for most of the dependent-care programs.

"Statistics reveal that white males will be a minority of

Workers helped set up the program in San Diego. A dozen employees from different functional areas convened and adopted short- and long-range plans dealing with family issues. "About 40 percent of the suggested programs were new and we've attempted to adopt them all, including child-care discounts, resource centers and the summer camp," said Convair manager-employee benefits Steve Woolley.

Most divisions have installed child-care referral centers. Data Systems-Western Center has hired a part-time dependent-care counselor.

At Fort Worth, Kathy Luper, services administrator, and Pam Carter, manager-total quality management, work with a Family Care Team of 10 Fort Worth employees researching dependent care. Eleven child-care libraries have been set up for workers. The team also surveyed area child-care services. Data on those that

responded were put into the VTX system, which is available through electronic mail. Employees can pick child-care centers by such categories as city, zip code, price, company discount, sick care or after-school service. The data will be updated periodically.

Fort Worth also has produced "Child-Care Resources," a guide that carries steps for selecting care and lists several providers.

Fort Worth has arranged for discounts to employees from some of the larger care providers. The Family Care Team also located care facilities for sick children in response to considerable employer interest.

At Electric Boat, the division's Employees Community Service organization has donated substantially to the Groton (Conn.) YWCA, across the street from the division, to offset fees for day care at the YWCA.

"They provide scholarships to low-income employees and provide a special sliding scale for Electric Boat employees," said Marjorie Lang, senior suggestion analyst.

General Dynamics' employee diversity program also includes elder and prenatal care.

Air Defense Systems' Rancho Cucamonga (Calif.) Facility has an elder-care program with seminars, support groups and a library. The division also has a prenatal-care program called Maternity Fraternity. "It's an incentive program designed to assist our pregnant employees and/or spouses of employees in learning how to help themselves and their babies stay healthier during pregnancy," Serra said.

The program involves reporting to a physician during the first three months of pregnancy, viewing a video on prenatal care, and attending a two-hour seminar on healthy child bearing. Members can select a gift or gift certificate for the baby.

■ Myron Holtzman



Children of General Dynamics employees participate in a project with a camp counselor at Missile Park.

those entering the work force in the year 2000," Serra said. "We must find more ways to attract quality women and minorities. If they see we are concerned with family problems and that we have facilities like the summer camp, we will be in a better position to hire and retain the best and the brightest men and women. They will be key to maintaining our competitive edge in the future."



Cruise control. The Air Force's Convair-built advanced cruise missile, shown during a test flight, made its public debut at the recent Air Force Association exposition in Washington, D.C. Designated AGM-129A, the missile has completed development and is in operational checkout with the 410th Strategic Bombardment Wing at K.I. Sawyer Air Force Base, Mich.

Savings and stock investment plans

	Annual rate of return for the 12-month period ending:		
	Aug. 1988	Aug. 1989	Aug. 1990
Salaried			
Government bonds	7.3%	8.9%	8.7%
Diversified portfolio	(18.4)%	39.4%	(6.4)%
Fixed income	10.9%	10.4%	10.1%
Hourly			
Government bonds	7.5%	9.0%	8.8%
Diversified portfolio	(18.8)%	40.3%	(6.5)%
Fixed income	10.8%	10.4%	10.1%
GD stock closing price	\$49.50	\$58.00	\$24.88
() Denotes negative number			

General Dynamics people, products play roles in Operation Desert Shield

U.S. forces that sped to the defense of the nation's interests in the Middle East in recent weeks relied on General Dynamics people and products. Employees at home and abroad supported forces in the field; a handful of workers even became part of those forces when reserve units were activated. Meanwhile, the Air Force, Army, Marines and Navy took with them an array of General Dynamics products, including F-111 and F-16 aircraft,

M1 and M60 tanks, Phalanx shipboard defense systems and Sparrow, Standard and Stinger missiles. Some of this equipment rolled off maritime prepositioning ships managed by American Overseas Marine Corp., a General Dynamics subsidiary. The stories on these pages highlight some of the company's efforts in Operation Desert Shield.

Electric Boat planner moonlights pumping gas into military planes bound for Middle East

When Mike Kuja tells his co-workers at Electric Boat Division he has to take off, he means what he says.

A planning analyst in the *Seawolf* planning department, Kuja is also a navigator in the New Hampshire Air National Guard. For the last two months, his unit—the 157th Air Refueling Group—has been going flat out, making sure that Persian Gulf-bound transport planes have enough fuel to get where they're going.

A participant in the multinational Desert Shield operation, Lt. Col. Kuja has been going flat out himself since shortly after the Iraqi invasion of Kuwait. During the weeks he's booked to fly, his schedule looks like this—leave work, drive 180 miles to Pease Air Force Base near Portsmouth, N.H., fly a refueling mission, drive back home, sleep, go to work, drive to New Hampshire, fly a mission... you get the picture.

It's a routine that would leave most other people in the dust. But Kuja has been blessed with stamina and the ability to quickly switch mental gears—from the planning details for the deep-diving *Seawolf* to the calculations required to rendezvous with a cargo plane at 25,000 feet.

If Kuja's commitment is exceptional, it's not unique. Nearly all the men and women in his unit have full-time jobs elsewhere. On a recent flight, for instance, the rest of the crew comprised a pilot who is a stockbroker, a co-pilot who flies for a commercial airline, and a boom operator who's a postman. Nonetheless, the 157th has managed to refuel more than 150 planes headed for the Middle East, which accounts for about a third of the total Air National Guard participation in Desert Shield.

Kuja has belonged to the New Hampshire Air Guard for 15 years, following a six-year stint as a navigator in the regular Air Force. It's his job to make sure the KC-135 tanker—a flying gas station that looks like a Boeing 707—meets up at the right time and place with the aircraft that's short on fuel. That's when things get interesting.

On a recent mission, Kuja and the rest of the crew left Pease, winging over the Atlantic toward Nova Scotia and a rendezvous with a giant C-141 transport. While science, mathematics and high tech help bring the two aircraft into the same vicinity, the actual linkup of two planes traveling at 450 mph is done the old-fashioned way—by eyeball.

During the moments before the refueling, the KC-135 pilots concentrate on flying straight and level. At the back of the plane, the boom operator guides the "receiver"

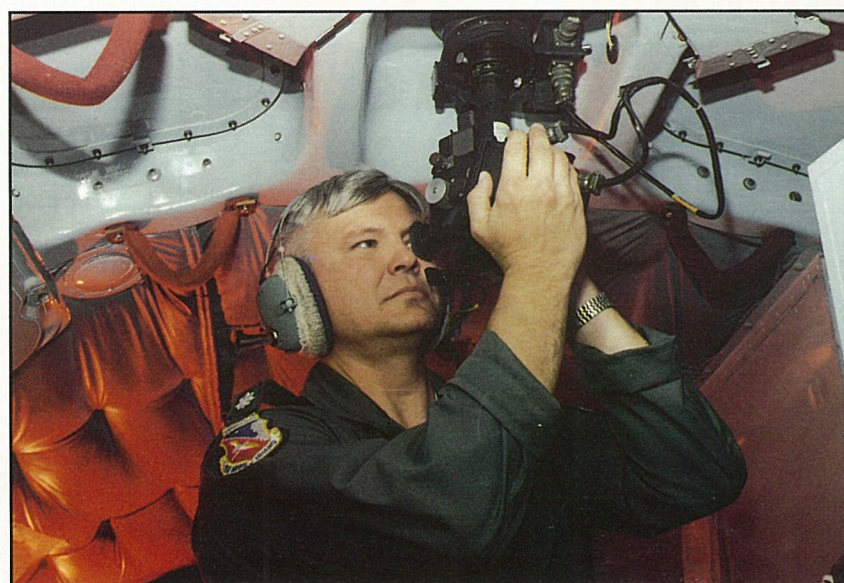
plane closer, both by voice and a series of color-coded signal lights on the bottom of his aircraft.

When the "receiver" is 20 or 25 feet away, the boom operator manipulates the boom, connects it to the other plane and starts pumping. In this particular refueling, the tanker pumped 74,000 pounds (11,400 gallons) of jet fuel in about 20 minutes, the time it took to fly from the south-

ing, going about its business with a minimum of fuss. Conversations are on a first-name basis, officers and enlisted personnel alike. "We've got such high levels of experience among our crews that our missions are just about second nature," Kuja says. "The only time things get a little hairy is when we're flying in heavy weather or if visibility is restricted."

There's no way to know how long the Persian Gulf crisis will last, but Kuja and the rest of his unit are prepared to juggle their personal and work lives to keep the air bridge open. "From my point of view, Electric Boat has bent over backwards to help me keep my commitment," he says. "And the people I work with have given me a lot of latitude as well—their attitude is 'what can we do to help you.'"

Ron Peterson, manager of *Seawolf* detail planning, notes that Kuja often works after hours and



ART AVERY PHOTOS



Top: Mike Kuja's KC-135 refuels a C-141.
Left: Kuja checks his bearings with a sextant.
Above: Kuja goes to work at his airborne desk.

ern tip of Nova Scotia to Cape Breton Island. After topping off, the transport banked away, headed for an Air Force base in Spain and eventually the Persian Gulf.

The time actually spent refueling varies by aircraft. A C-5, the largest plane in the western world, takes at least 40 minutes to drain a full 160,000-pound load of fuel from two KC-135s flying in formation. At the other end of the spectrum, an F-16 can swing by for a quick 1,000 pounds and be on its way in 15 seconds.

There's no doubt that in-flight refueling involves an impressive depth of skill, but the crew foregoes swagger-

on weekends to get his Electric Boat tasks done. "Obviously, we have a job to do here," says Peterson. "But I think the situation in the world at the moment means that we have to try to accommodate people like Mike."

When asked how he manages a schedule that has him working, sleeping, driving or flying, Kuja says: "I consider myself rather patriotic. Another reason is that what I'm doing is just plain fun—the people I fly with are highly skilled professionals and I enjoy the camaraderie. It's quite a change of pace to go from being a *Seawolf* planning analyst to a crew member on an air-refueling mission. It makes life pretty exciting."

■ Dan Barrett



MILT ST. ONGE

Land Systems helped modify these three Fox vehicles for U.S. troops. One was sent to Dugway Proving Ground in Utah for testing in sand and will eventually remain at the Army Chemical School at Fort McClellan, Ala. The other two vehicles were expected to go to Saudi Arabia.

Land Systems fixes Foxes on the double to detect nuclear, chemical and biological contaminants in field

Land Systems Division personnel joined representatives from the government and foreign firms in an international effort to Americanize three German Fox vehicles for Operation Desert Shield.

A six-wheel-drive, 18-ton sophisticated reconnaissance vehicle, the Fox detects nuclear, biological and chemical contaminants and communicates their presence to nearby units. Land Systems and Thyssen Henschel, a German firm, won a contract earlier this year for an enhanced version of the Fox. Thyssen Henschel made the original model of the Fox used by the armies of Germany and several other NATO countries.

The U.S. Army directed an international team, including Land Systems, in a crash effort to support crew training and to modify the vehicles for Operation Desert Shield. The team integrated U.S. grenade launchers, radios, intercom equipment, nuclear, biological and chemical sensors, and machine guns into the vehicles and painted the vehicles with a chemical-resistant coating. The work was completed on schedule in seven consecutive days.

"We could never have completed this project if it weren't for the tireless work of all involved," said Steve Czerniak, Land Systems Fox engineering project manager. "The challenges were great and the hours were long, but the cause made it worthwhile. All I had to do was think of the safety of our military personnel in Operation Desert Shield, and I got all the energy I needed to continue. The entire team made this project happen, and I'm proud of them."

The Land Systems team included representatives from the Fox Program Office and the engineering, quality, logistics, material and manufacturing functions. Engineering provided technical guidance and modified the vehicles. Quality performed technical inspections of the vehicles and audited support equipment. Logistics trained crews, maintained inventory of hardware received from the government and developed a system support package. Logistics also managed the speedy shipping of hardware from various Army depots and forwarding of hardware to Thyssen Henschel in Germany for follow-on Americanization of additional German vehicles. Material expedited

needed buys. Manufacturing managed welding techniques.

"Government personnel worked directly as part of the team to complete this difficult job," Czerniak said. Joe Callahan, deputy assistant project manager of the Fox program, and Al Price, representing the Army Fox program manager, served as liaison to resolve problems in availability of government-furnished equipment and information. George Gorlewski, Army Communication and Electronics Command, led the integration of communication equipment.

Peter Keller of Thyssen Henschel supported vehicle

modifications by performing scheduled maintenance and correcting deficiencies found by Land Systems quality assurance during technical receiving inspections.

Bill Claytor and John Wronka of Bruker Instruments, a subsidiary of Bruker Franzen, a German firm, verified the readiness of the mobile mass spectrometer for the Fox, supported crew training, and assisted in the integration of other sensors.

George Kontis of FN Manufacturing, Inc., a subsidiary of Fabrique Nationale, a Belgium firm, developed and delivered a mount to allow the integration of the M240E1 machine gun.

■ Jack Price

GD Services Co. expands Saudi presence to support U.S. forces

General Dynamics Services Co. has begun its own Saudi Arabian buildup in support of Operation Desert Shield.

The company, which has been retained by the Saudi Arabian government for the last two years to perform various services, has rapidly expanded its presence there to provide maintenance support for the U.S. Army. The Army required significant logistical backup because of its rapid deployment to Saudi Arabia and the fact that much of its maintenance support capability is in Army Reserve and National Guard units.

General Dynamics Services Co. was well-positioned to satisfy the Army's needs. Together with Mansour General Dynamics Ltd., the company's joint venture partner, General Dynamics Services Co. is refurbishing and converting 150 Saudi Arabian M60A1 tanks to M60A3 (TTS) configurations. Technical personnel are also stationed in nearby Bahrain to help that nation integrate recently purchased F-16 Fighting Falcons into its air force and automate their logistic system.

Following two days of briefing the Army in Detroit and Saudi Arabia about the company's capabilities, General Dynamics Services Co. received a telephone call from the U.S. government on Aug. 28 to begin support of Operation Desert Shield. Although the go-ahead came at 2:30 a.m. Saudi Arabian time—7:30 p.m. Eastern the night before—the company responded immediately. Employees, vehicles, equipment and supplies were moved from two Saudi Arabian cities to where they were needed in another

city and were ready to begin work the next day.

Government and company officials in the United States worked through the night to negotiate a contract. The contract was signed Aug. 31, but the task had just begun. Employees worked through Labor Day weekend to recruit additional personnel and find housing and other facilities in Saudi Arabia. Twenty-three technical specialists, led by Program Manager Bill Marcantel, were in Saudi Arabia by Sept. 8. Thirty-four more technicians were scheduled to join the group in early October.

General Dynamics Services Co. is also participating in a separate effort to field Fox nuclear, biological and chemical reconnaissance vehicles. The Fox is used by the German army but is still in preproduction in the United States, where Land Systems Division and Germany's Thyssen Henschel have teamed to make the vehicles.

The German army is providing Fox vehicles to the U.S. Army for Operation Desert Shield. Since the U.S. Army has no support network for the Fox, Thyssen Henschel contacted General Dynamics Services Co. to provide those services. After contract signing on Sept. 6, the company sent 14 people to Thyssen Henschel for maintenance training and nine more went to Saudi Arabia to set up logistics. The 23-person team was scheduled to consolidate in Saudi Arabia in early October. Eighteen more technicians will be deployed if the Army exercises its option with Thyssen Henschel for more vehicles.

TQM

CASE STUDIES

Cessna's teams come up with million-dollar ideas to improve manufacturing

Total quality management translates into big savings realized through the efforts of more than 200 employees at Cessna Aircraft Co.'s components manufacturing facility.

The workers serve on two types of teams. Employees representing every manufacturing department make up employee involvement/statistical process control teams that improve manufacturing processes. Project task teams support and implement the improvements.

The teams are reaping big rewards for their work. Twenty-two employee involvement teams, each comprising eight to 12 people, have addressed more than 700 issues and have documented savings or cost avoidances exceeding \$4 million. Three hundred more issues are being addressed.

The issues include poor quality, productivity, quality of service and the workplace, supplier-customer expectations, material handling and selection, training, process control, teamwork and mutual respect. Tackling these issues is the components manufacturing facility's means to become the best it can be through continuous improvement.

"Early TQM efforts were designed to give operators control of their processes," said Ron Alberty, facility manager and task team member. "The original concept was soon expanded to provide individual employees, working in a team, with a method to contribute their special skills and knowledge to problem-solving activities."

"The process gives tangible benefits while building trust and respect for the contribution of each employee."

One of those tangible benefits is that the total quality management process helped cut scrap by 50 percent in the composites fabrication area for the first half of 1990. "Many of us were doubters when the process was first introduced," said Glen Stevenson, a composites superintendent and task team member. "We had seen so many programs come and go. But I soon realized that my management philosophy, which I consider to be people-oriented, and that of employee involvement/statistical process control, were very similar. Everyone's input is needed and individual employees should get the credit they deserve."

One valuable lesson learned by employees is the need for data. "Documentation is one secret to success, but it's easy to forget to continue collecting data over time," said Loiann Edwards, precision assembly team member. "Sometimes we stop documenting and the problem comes back." ■ Max Shellenberger



Missile assembler Tony Kennedy records data from a cruise missile production team-building session.

Convair takes team approach to thrive

For the 5,000 employees of Convair Division's operations function, team-building is the key to becoming a world-class organization. With nearly 60 percent of the division work force, operations includes all factory activity for Convair's three major product lines—Tomahawk cruise missile, advanced cruise missile and MD-11 aircraft.

A little over a year ago, Ken Lake, vice president-operations, began an internally developed team-building process facilitated by the Convair organization development department. Starting with Lake's staff, team-building sessions have continued throughout successive levels of management and their staffs and will culminate with first-line supervisors and their hourly employees by mid-1992.

Convair human resources specialist Lisa Ethier has led team-building since June 1989.

Team-building assesses how the team functions and identifies ways for people to work better together. A team-building facilitator discusses with the group data gathered through interviews and questionnaires. The team considers morale, problem-solving, conflict, readiness for change and job satisfaction. The leader is given feedback about his or her leadership style and a chance to talk with the group about the things that can be done to help the team function more effectively.

"Team members may work side by side every day, but team-building provides a chance for them to talk about things in a new way, not only to work on problems but to get to know each other better," Ethier said.

Each of the operations departments completes the eight-to-16-hour session. Feedback has pointed out the need to go beyond the vertical department. "Everyone kept saying that the team-building sessions were great but there was a need for cross-function sessions," said Jim McIntyre, director-cruise missile production.

To that end, Lake and his staff implemented a cross-functional team-building process. McIntyre and Norm Pearl, director of fabrication and production engineering, volunteered to undertake the first cross-functional effort. One of the teams represents all of the processes that have to come together just before a Tomahawk is delivered to the customer. It's a complex process involving paperwork and hardware issues and people representing assembly, engineering, quality assurance, logistics and human resources as well as the customer.

"It's rewarding to see measurable results from the seeds that were planted in the last year and a half," McIntyre said. "This is not a one-shot deal. It is a planned progression that started at the top. It's constant improvement in everything we do."

■ Julie Andrews

General Dynamics receives its first parts 'just in time'

A New York firm recently sent parts to Land Systems Division that are the first of their kind at General Dynamics.

Niagara Development and Manufacturing now delivers parts to the Detroit Arsenal Tank Plant and the Lima (Ohio) Army Tank Plant "just in time" for production of M1A1 Abrams tanks. The company supplies heat exchangers and engine oil and transmission oil coolers.

"Just in time" is a system in which vendors provide defect-free parts exactly when they are needed for assembly. The object is to reduce inventories to zero.

"Niagara's commitment to continuous improvement is clear," said Edward D. Lewis, a statistical process control coordinator at Land Systems. "Their tradition of delivering quality and cooperation as well as parts continues. They were our first supplier to be

certified in statistical process control, and their outstanding quality enabled us to delegate product inspection and acceptance responsibility to Niagara and eliminate our in-plant receiving inspection."

Just-in-time production deliveries are part of Land Systems' streamlining of the parts-to-manufacture process. The schedule requires deliveries about every two weeks in manufacturing lot sizes. The parts are received and moved directly to the shop floor "just in time" for installation. The process eliminates inspection and warehousing by Land Systems and saves significant material handling and inventory holding costs.

"Niagara's unparalleled team spirit made the deliveries possible," said Barbara Motala, procurement chief. "They unhesitatingly agreed to stop deliveries so that our inventories could be reduced and the bene-

fits of just-in-time delivery realized. Our success stems from a partnership based on the philosophy of total quality."

The effort paid off as the inventory value on Niagara parts was reduced 90 percent in four months, according to George P. Boyer, a Land Systems buyer.

"Just-in-time delivery is a key division program," said Thomas A. Bledsoe, Land Systems vice president-material. "To cope with the challenges of the '90s we must take a new approach to inventory management. Just in time is the vehicle to get us there."

Monty Dickinson, corporate vice president-material, added, "This accomplishment represents a model of what each division is trying to implement to reduce in-house costs and inventory and improve turnover."

■ Jack Price

Killer tornado draws outpouring of aid, equipment, money

Equipment and operators from Material Service Corp. were among the first on the scene following the most devastating tornado to hit the Chicago area since 1967.

The Aug. 28 tornado cut a swath seven miles long and 300-700 feet wide through parts of Cresthill, Aurora, Plainfield and Joliet. Winds up to 250 mph killed 28 people and injured more than 300. Hundreds of homes and other structures, including three schools, a church and two apartment buildings, were destroyed. Damage is estimated to exceed \$135 million.

Material Service heavy equipment, including two front-end loaders and a crane, arrived in Cresthill shortly after the tornado hit. The equipment removed debris to permit emergency vehicles to move in, search for victims and administer medical attention. The Material Service equipment team, consisting of Romeoville quarry employees Roger Blake, Lloyd DeRossett, Tom Van Cura and Steve Jackinowski, worked until late that night.

They were joined by many other Material Service employees. Romeoville quarry and Lockport shop management, including General Manager-Maintenance and Equipment Craig Goldstone, Area Manager John Halloran, Ray Egly, Rich Ellis, MaryRose Ramacci, Bob Wheeler and Bob Wilson, coordinated Material Service's aid. Ron Dana of the radio shop kept in contact with Material Service equipment from the company communications van dispatched to the scene. Radio Shop Manager Bill Diaz handled communications back at the facility.

The radio shop's Terry Berg, who is also president of the Gypsy Amateur Radio Society and a member of the



Material Service equipment removes debris left by the tornado.

local Emergency Services and Disaster Agency, coordinated ham radio calls throughout the area to the agency's disaster command post. He dispatched food, water, fuel and medical supplies from the post.

The heavy equipment team resumed work Aug. 29 by removing autos hurled through the streets and loading other debris into dump trucks bound for incinerators.

At the request of the Will County Sheriff's Department, heavy equipment operators George Stuck and John Fink knocked down, crushed and removed structures that were beyond repair. Romeoville quarry superintendent Ted Doll supervised the operation.

Material Service equipment and operators participated in the cleanup for the next week. Many other employees, some of them listed below, pitched in:

- Lockport Pipe Plant Superintendent Bob Ashbaugh

and Systems Analyst Bob Isgren and his wife Virginia helped distribute clothing, food and medical supplies at area churches.

- Scott Jackson helped clean victims' homes and Mike Evans operated heavy equipment on Labor Day. Both men work at the pipe plant.

- A group boarded up and secured the heavily damaged home of Material Service engineer Dick Spese. Pitching in were Vice President-Concrete Products/Engineering Klaus Rosenstern, Roger Miller, Ron Olchawa, Dan Duda, Dean Milenkovic, Lyndon Dean, Dale Garman, Carl Colby, Bob Hernandez and Jerry English.

- Assistant Marine Manager Jack Moore was away on vacation when the storm hit his home. His son-in-law, Tim Tarver of the pipe plant, and marine employees Ken Roecker and Wes Howard helped secure the house.

- Tom and Terry Van Cura, Ron Deuter, Rico Arambula, Jim Becker, Francisco Bibian, Roger Blake, Pete Palacios and Jose Martinez helped repair the damaged home of fellow Romeoville employee Reese Evans.

- Gene Carcerino and Steve Mlekowski hauled away debris in a dump truck for several days.

The company and its employees also opened their pocketbooks. Material Service and Marblehead Lime Co. employees contributed more than \$7,000 to disaster relief and the Material Service Foundation added \$8,000 for a total of more than \$15,000. ■ Peter Stamos

Officials see Soviet aircraft factories

Six representatives of the Fort Worth Division were part of a U.S. delegation that recently made a historic visit to the Soviet Union's principal aircraft design and production facilities.

Charles A. Anderson, then serving as Fort Worth's vice president and general manager, Edward M. Petrushka, vice president of research and engineering, and Charles N. White, vice president and general manager of the division's Tulsa, Okla., assembly facility, formed the nucleus of the group. Anderson has since been assigned as A-12 program director.

Kevin Dwyer, flight test director for the A-12 program, and two representatives of Fort Worth's advanced design department, Richard Ward and Reuben Johnson, also made the trip.

The group toured several design bureaus and research facilities in Moscow, including the Mikoyan plant where the MiG-29 fighter is produced; TsAGI, Russia's central aero- and hydrodynamics research institute, which is similar to NASA; IsIAN, the central institute for aircraft engine development; and the Soviet Union's institute for aviation and space medicine.

The group also visited the Antonov design bureau and flight test facilities in Kiev, where the world's largest aircraft, the An-225 transport, is produced.

Several aspects of the Soviet facilities made strong impressions on the visitors. The quality of the research laboratories, which indicates a major commitment to developing new technologies and products, impressed Anderson.

The factories are relatively low-technology compared to U.S. facilities, yet are able to produce fighters such as the MiG-29 and Su-27 that are known for outstanding flying performance, White said.

"Their problems in designing airplanes are exactly the same as ours," said Petrushka. "They were far more open than I thought they would be."

The everyday people the group met also made an impression. "We saw people that were very happy, very hospitable...some of the warmest people in the world," Petrushka said. ■ Joe Stout



Peg Kennedy holds a youngster at the Home of Love and Compassion in Garbage City.

'Dynamic woman' helps Cairo's kids

When Tom Kennedy went to Cairo for General Dynamics Services Co., the people of Egypt received much more than assistance with building tanks. Kennedy's wife, Peg, helped some of the less fortunate of Cairo make their lives a little better.

While Tom was busy as the superintendent of field construction on the Egyptian tank plant program, Peg was caring for the people of "Garbage City."

Most visitors to Cairo have probably not toured Garbage City. Located in an area of Cairo called Mokkatam, it is home for the city's poor who survive by collecting garbage.

Peg wanted to work with people who needed assistance, but the language barrier in Egypt posed a problem. "You have to find places where you can help and communicate," she says. Mother Theresa's Missionary of Charity Sisters provided such a place.

The Home of Love and Compassion is a refuge for women and children operated by the Missionary of Charity Sisters in Garbage City. There is a clinic provided twice a week, a kindergarten for 100 children, and facilities for 23 live-in youngsters.

Peg was not the only General Dynamics spouse who helped at Garbage City. "The Dynamic Women" as the group was called, coordinated a project that each week donated 20 pounds of eggs.

"The GD women were very, very generous with time and money," Peg says. "Every winter we'd do things for the kids at Christmas. We would try to give them a sweater or something warm."

The Dynamic Women are an outstanding group, Peg says. "I was not only impressed, but touched," she says. "If I ever said that there was a need, people would run to their closet or pocketbook."

When Tom retired in July, the Kennedys returned to the United States. They are enjoying life in Texas, but they have fond memories of Cairo. "The people are lovely," Peg says. "They have nothing. They should be dissatisfied, but they have different expectations. They are used to doing without."

Peg helped many children in Garbage City. She's taken many photos of them back to Texas—and many memories, too. ■ John Corrigan

Employees rise to the occasion by not getting a lift

Fort Worth Division's material department conducted an unusual incentive program recently. To convince employees to save time by taking stairs rather than waiting for slow elevators, the department placed rewards in the stairwells—coupons good for fresh fruit, toothbrushes and similar health-related items.

The monthlong program sprouted from the observations of Jim Mercurio, Fort Worth's vice president-material. He noticed that slow elevators were a problem when he came to Fort Worth from Land Systems Division a few months ago. The material department occupies leased space in the Hulen Towers complex, which is separate from other division facilities.

The material department has a program, "Live For Life," that is the division's pilot for an on-site employee health initiative. Mercurio saw potential for solving part of the elevator problem by adding a new aspect to Live For Life.

"Our objective was to increase people's efficiency

and productivity by combining their use of the stairs with their involvement in Live For Life," he said.

The 2-year-old Live For Life effort has increased employees' health awareness through many activities, including on-site fitness and lifestyle assessments, stop-smoking and stress management classes, lunchtime aerobics and an on-site fitness center.

Live for Life administrators put coupons for prizes in boxes on the Hulen facility's stairs three times each week without notice. "The only way people could get a coupon was to walk down the stairs and pick one up," said Pam Carter, Live For Life and total quality management program manager.

The coupons had to be redeemed the same day, which ensured that one person couldn't use all the coupons in the box. Nearly 400 coupons were turned in during the month. Stairs traffic increased considerably.

The program appeared to be a success because

groups of employees waiting for elevators became a less frequent sight during the four weeks, according to Mercurio. "Hopefully we started a new habit for some people—taking the stairs when it's practical," he said.

■ Joe Stout

Program takes cuts at health costs

Fort Worth Division's "Live For Life" program is being expanded from the Hulen Towers facility to several of the division's other locations this year.

Fort Worth's Electronics Manufacturing Center became the second Live For Life site in early 1990. Two office complexes operated by the logistics and support department followed in the second quarter. Two more facilities are scheduled to start the program this fall.

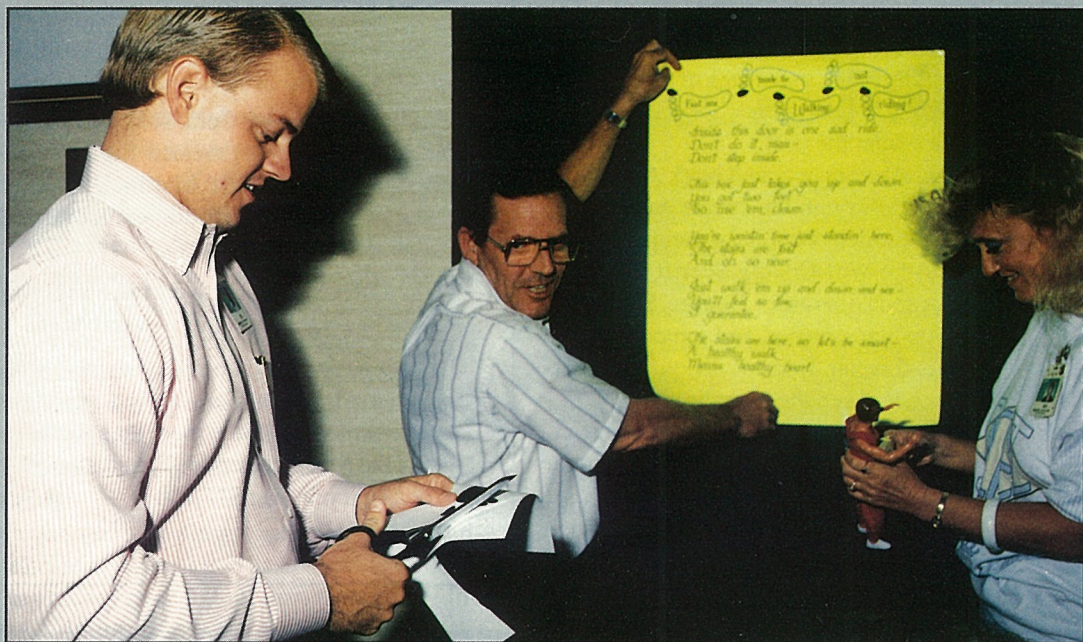
"Live For Life addresses multiple objectives," said Pam Carter, manager-total quality management. "It addresses one of the root causes of escalating health care costs, unhealthy employees. By creating a supportive environment for employees to make lifestyle changes, the company can help them prevent lifestyle-related illnesses."

More than 50 percent of the employees at Hulen Towers, the pilot site, participate in at least one Live For Life class or activity. The program has impacted the participants' health care costs measurably, Carter said.

Many employees take aerobics classes or use fitness center equipment before or after work or during their lunch periods. Others walk or jog.

Participants receive a comprehensive health assessment and the opportunity to take classes in nutrition, cholesterol management and similar subjects.

■ Joe Stout



Fort Worth employees (from left) John Brunet, Larry Womack and Robin Phillips decorate the door of an elevator that doesn't operate on General Dynamics floors. The decorations were part of a contest to encourage employees to use the stairs rather than the building's other elevators.

MORRIS BRANDON

Unmanned ground vehicle draws crowds in public debut

The advanced technology of an unmanned vehicle produced by a Land Systems Division/John Deere team surprised the competition and the Department of Defense during a demonstration at a recent national symposium in Dayton, Ohio.

Land Systems and John Deere, a manufacturing firm with headquarters in Illinois, submitted a proposal in July for a robot system called a surrogate tele-operated vehicle. The Army and Marine Corps will use the vehicle for training and developing robotic vehicle doctrine.

The team used the national symposium of the Association of Unmanned Vehicle Systems to introduce its candidate. The demonstration went beyond the requirements of the surrogate tele-operated vehicle program by illustrating Land Systems' advanced technologies in artificial intelligence and communications.

Land Systems engineers from the artificial intelligence laboratory and the communication link enhancement group presented live demonstrations at the symposium. Stereo images picked up by cameras located on top of the vehicle in one booth were transmitted to the machine perception system located in a second booth over narrow-band military radios using a video data compression system. A machine perception system then created a range map of the obstacles in front of the cameras. A three-dimensional obstacle map was also created to show perspective.

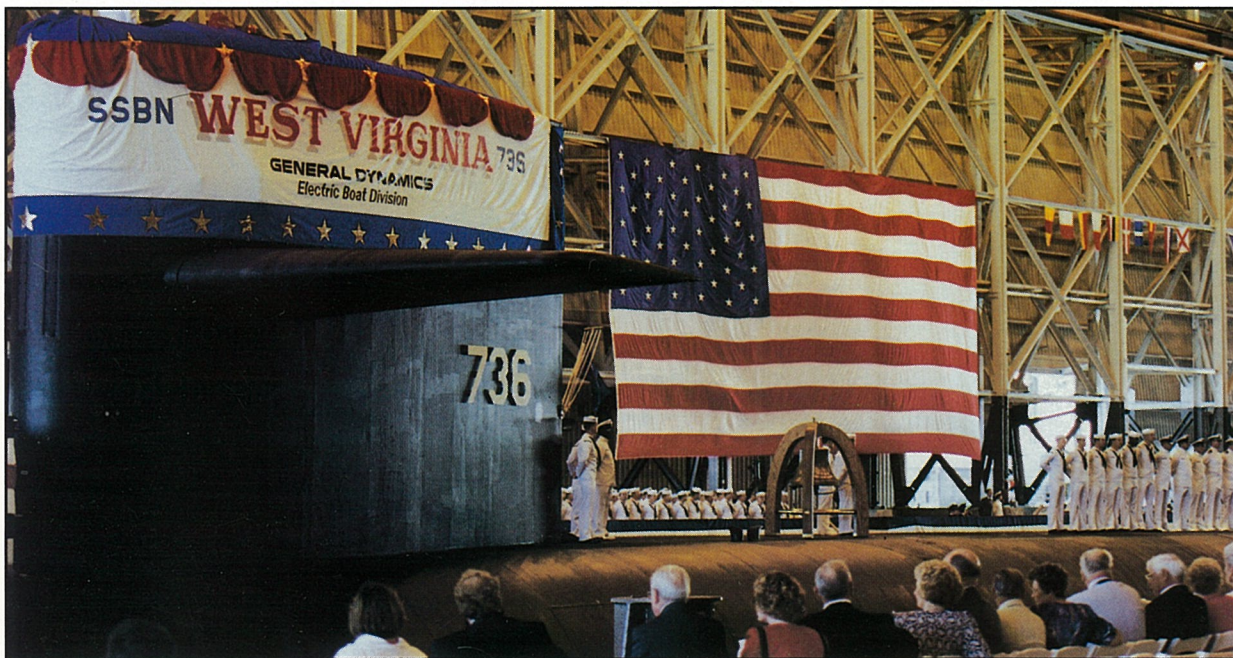
The audience included representatives from the government office managing the program and representatives responsible for developing the advanced technologies that will lead to autonomous vehicles.

"The Land Systems/John Deere demonstrations were a major attraction of the exhibit," said Edward D. Hill, Land Systems advanced technology programs marketing manager. "At one event we were able to demonstrate our capabilities both for today and tomorrow."

■ Jack Price



A Land Systems/John Deere unmanned vehicle simulates a reconnaissance mission in computer-generated terrain imagery.



Navy's newest. The USS *West Virginia* joins the Navy during recent commissioning ceremonies at Kings Bay, Ga. See story on page 2.

TOM RULE

GENERAL DYNAMICS

World

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Collider deal for Space Systems

Space Systems Division and Westinghouse Electric Corp. have been selected for a \$200 million contract to complete the design and begin high-volume manufacture of superconducting dipole magnets for the Superconducting Super Collider.

Space Systems will be the leader and Westinghouse's Collider Dipole Division the follower.

After a step-by-step evaluation of a series of prototype and preproduction magnets, 502 units will be produced for installation in the Super Collider. The two firms will then compete for a follow-on production order for the remaining 8,200 superconducting dipole magnets, each about 52 feet long and weighing 12.5 tons.

The magnets are an essential part of the Super Collider particle accelerator. They will guide beams of high-energy protons around the accelerator's rings at about the speed of light and bring the protons into collisions. Massive detectors will record the results and enable scientists to learn more about the fundamental nature of energy and matter. The magnets will operate at a very low temperature—near absolute zero—at which the electric-

ity that powers the magnets will flow without resistance.

Space Systems will work with the Superconducting Super Collider Laboratory to produce 15 prototype magnets for test and evaluation. Each firm will then produce 35 preproduction magnets, which the laboratory will test and evaluate, beginning in 1993. Each firm will then make 251 magnets for installation in the accelerator. Both firms will prepare competitive bids for the remaining 8,200 magnets.

Space Systems will make magnets in Hammond, La. "We have been working for five years for this most significant win," said Bob Johnson, Space Systems manager-energy programs. "Our energy programs team did an outstanding job in preparing us for this exciting opportunity."

The Superconducting Super Collider, the largest instrument ever designed for scientific research, is to be built in Ellis County, Texas, 30 miles south of Dallas. The accelerator will be used by scientists for a variety of experiments that should yield new knowledge about the fundamental building blocks of the universe.

Land Systems guns for breakthrough with electrothermal firing system

Land Systems Division broke ground Oct. 30 for a center to research a potentially revolutionary gun system.

The facility, called the Mason Technology Center in Apple Grove, W.Va., will work on electrothermal technology to propel projectiles from guns mounted on tanks and other weapon systems.

Electrothermal gun technology is a new patented process. It replaces conventional gunpowder with a high-energy electrical pulse provided to a chemically active but non-explosive propellant in the gun chamber.

"By using electrothermal technology instead of a conventional chemical propellant, we should be able to generate twice the energy in a gun system while greatly improving crew survivability," said Gordon England, vice president-research and engineering. "Electrothermal has exciting possibilities because it should be more efficient, less expensive and much safer than conventional chemical propellants. And it can be adapted to current guns, using current ammunition or electrothermal ammunition interchangeably."

Electrothermal technology has been proven in small-scale laboratory gun testing. The technology has also been effective in previous testing on the 120mm main gun used in Land Systems' M1A1 Abrams tank. Additional research and development are necessary before fielding this technology.

The Navy has contracted with Land Systems to develop this technology for air defense weapons. Land Systems is completing a contract with the Army for 120mm applications. The company expects to receive an Army contract to further develop the technology for tanks and artillery. Development and growth of the Mason Technology Center will depend on continued Department of Defense contract support.

The 264-acre Mason Technology Center is 26 miles north of Huntington, W.Va. The center will consist of five structures costing about \$3.5 million. The facility will include a target area with a canopy, an instrumentation building and a power supply building. Initial construction should finish in spring 1991.

News Briefs

Quarterly earnings fall owing to F-16 downturn

Reduction of the earnings rate on the F-16 program was primarily responsible for third-quarter earnings dropping \$8 million compared to third-quarter results in 1989.

The company reported net earnings of \$68.5 million, or \$1.63 per share, on sales of \$2.5 billion. Third-quarter 1989 earnings were \$76.5 million.

The drop in F-16 earnings "is partially attributable to costs associated with the activity returning the F-16 deliveries to contract schedule during the quarter but also gives some recognition to the cost pressures as we transition to lower production rates," Chairman and Chief Executive Officer Stanley C. Pace said.

General aviation sales in the first nine months of 1990 jumped 25 percent over 1989, paced by deliveries of Cessna Aircraft Co.'s Citation V business jet. Prospects of international sales of the M1 tank increased, particularly to U.S. allies in the Persian Gulf region.

o o o

Five Centaur stages sold

Space Systems Division has sold five additional Centaur upper stages in a \$275 million follow-on contract from Martin Marietta Space Launch Systems Co. The Centaurs will be used with Titan IV boosters. The follow-on order brings the contract quantity to 15 Centaurs; the first unit will be delivered to Cape Canaveral Air Force Station, Fla., later this year. The Titan IV/Centaur combination provides heavy-lift capabilities for Air Force missions.

o o o

Software conference set

Data Systems Division will sponsor the annual General Dynamics Software Technology Conference in San Diego April 10-12.

Organizers are soliciting papers on any aspect of the company's deliverable and support software. One-page abstracts are due Dec. 21. Submittals should include a cover sheet with full name, EM/OS address, department number and name, business address and phone number.

Abstracts and other information should go to Diane Watson, Data Systems-Western Center, P.O. Box 85808, San Diego, CA 92186, Mail Zone W2-5530. Watson's phone number is (619) 573-3792 and EM/OS address is WATSON,D.

o o o

Anders inducted into hall

Vice Chairman William Anders has been inducted into the International Aerospace Hall of Fame in San Diego along with his Apollo 8 crewmates Frank Borman and James Lovell.

The three astronauts became the first to orbit the moon when their Apollo capsule circled the lunar surface in December 1968. The hall of fame also inducted Russian space pioneer and rocket scientist Sergei Korolev.

o o o

Contest winners next month

The 12 winners and 36 runners-up in this year's employee photo contest will be published in the December issue of *General Dynamics World*. All 48 award-winning photos and the names of the top 100 vote-getters will appear in a 1991 calendar that will be distributed separately next month.

Company ad... pages 4, 5

Current & Comment

Smiles only, please

A writer with a major metropolitan newspaper recently stepped over the line in the sand. He accused the defense industry of lacking a sense of humor.

A hurtful indictment, indeed. No sense of humor?

On the one hand, it might be said, ours isn't really meant to be a funny business. But on the other hand, no one likes to be thought of as humorless.

Whatever, it's a charge that shouldn't go unexplored. Perhaps worthy of an investigation by a congressional oversight committee or the Justice Department. After all, even Saddam Hussein, the bad-dream look-alike of the little man on top of the wedding cake, makes a joke now and then. Some very bad ones, in fact.

Certainly, someone should get the facts. A missing sense of humor isn't acceptable. Right now, the world needs all the laughs it can get. From every sector of society, including ours. The entertainment industry is doing its best to make sure we have an unbroken string of happy days and nights. Our TV menu is brimming with enough earthy mirth to amuse all age groups. And surely some of the art being displayed in American museums (courtesy of our tax dollars) can only have been meant to make us smile. We're grateful, too, for the hilarious off-stage performances of elected officials at all levels. Quite often, they're funnier than the TV shows—sometimes even deliberately.

So it's disappointing to be told that in such otherwise lighthearted times our industry has failed to test positive for fun. If only that reporter had bothered to ask us, we could have enlightened him. Aren't many of us shareholders in defense or other stocks? Surely, that requires a sense of humor these days. Don't we grin and bear it as political candidates, editors and anchormen cheerily mutilate the names and capabilities of products that we've spent half our lifetimes working on? And haven't most of us labored agreeably over endless security clearance forms printed in type the height of an ant's leg? Forms asking questions like: "Have you ever used any depressant, stimulant, deodorant, smokeless tobacco or skin cream?" or "Account for all periods of time for the past 25 years and give names of 15 good friends (not relatives or co-workers) who can attest to same with maps showing location of their most recent residences." I'd like to see some hotshot cosmopolitan journalist smile his way through a few of those.

It's likely that most of us also have a favorite story about the company or the industry. One that's well-remembered here concerns a time long gone by when a dozen or so Halloween masks were made from an enlarged portrait of the chairman and CEO. The plan—to spook a middle-management speaker at a working department dinner—nearly backfired when the chairman himself showed up unexpectedly. There are those who to this day still carry the scars of their own fingernails on their faces.

What's done is done, however. In our company, we're probably as much to blame as anyone for the industry's dour reputation. For example, it wasn't so long ago that a local public relations firm, after exhaustive brainstorming, urged us to send out each company news release tethered to a pink helium-filled balloon—both packaged in a big cardboard box for special delivery to hundreds of newsrooms. In retrospect, we shouldn't have vetoed the idea; it surely would have brought grins to the faces of city editors and their staffs all across America. Much the same, in fact, as their own product so often brings to us. ■ Peter K. Connolly



Dressed to date. Tharogem, a robot funded in part by General Dynamics and Electric Boat Division for the Thames Science Center in New London, Conn., was one of the eligible "bachelors" auctioned recently to benefit the New London Chapter of the American Cancer Society. Spiffing up Tharogem for his "date" are Jan Miller (right), a work authorization planner at Electric Boat and a member of the society's board of directors, and Bobbie Seebeck, auction chairperson. Tharogem was programmed for his date with an hour-long presentation of his sonar, light and motion detectors and singing, dancing and sound effects.

JIMMY BRENNAN

West Virginia homes in on commissioning

For the first time the commissioning ceremony marking the official entry of a Trident-class submarine into the Navy occurred at the base where the vessel will be homeported. USS *West Virginia*, the 11th Trident ballistic missile-firing submarine delivered to the Navy, was commissioned Oct. 20 at the Navy's new Trident base in Kings Bay, Ga.

All of the Trident vessels have been built by Electric Boat Division. *West Virginia* is the third in its class to carry the D-5 Trident II missile.

Commissioning ceremonies for Tridents had been held on the Thames River in New London, Conn., across from Electric Boat's Groton shipyard. The Navy moved the *West Virginia* commissioning so the crew's families, who had already relocated to Kings Bay, could attend.

Christened at Electric Boat in October 1989, *West Virginia* had exceptional sea trials before delivery, Electric Boat General Manager James E. Turner Jr. said during

the ceremony. "The success of submarine sea trials reflects on the training and ability of the crew, as well as the material condition of the submarine," he said. The submarine was delivered ahead of schedule, "maintaining the record of early deliveries for the Trident class and demonstrating our continued dedication to deliver quality and cost-effective products to the Navy," Turner added.

Principal speaker Robert C. Byrd, senator from West Virginia, said, "Our role in the world remains needed, and this ship symbolizes it—an expression of power only to be used against those who challenge us and the values that we and our allies cherish and represent." Addressing the crew, he concluded, "I have no doubt that you will account yourselves in the finest of our traditions, and that this ship will acquit itself so as to foster our pride, as have the many great ships (before)." ■ Graham Gavert

Atlas engines: Reusable commodities?

Space Systems Division is studying the possibility of taking recycling to new heights.

The product under consideration is not an aluminum can or an old newspaper. It's the liquid-fueled engines proposed for the Air Force/NASA Advanced Launch System.

The system is a family of launch vehicles that will support the nation's launch requirements in the next century at significantly lower costs than today's vehicles. To achieve this goal, Space Systems has proposed recovering and reusing the vehicles' engines. Up to now, only solid-fuel rocket propulsion systems have been recovered for reuse.

To prove the concept, Space Systems is designing a system to recover and reuse the two engines in an Atlas E thrust section under the Booster Recovery Module Advanced Development program, funded by the Air Force under the Advanced Launch System.

"The project will provide significant insight into potential cost savings and the feasibility of reusing engines, which are one of the high-dollar components of the launch vehicle," said Craig Fitzgibbon, program manager.

"Our Space Systems project team intends to mount the recovery system built by Thiokol Corp. on an Atlas E thrust section during an actual Atlas E launch from Vandenberg Air Force Base," said Mark Sedillo, program chief engineer.

Sedillo explained that recovery will begin approximately two minutes into the launch when the two booster engines have completed their burn. The Atlas vehicle will jettison the thrust section and its propulsion system. The recovery system will deploy a drogue parachute to

stabilize the thrust section and then will open three main parachutes to slow the thrust section to an acceptable water-entry velocity.

A flotation device will open in the water so the thrust section can be retrieved in the same manner as the space shuttle's solid rocket boosters. Rocketdyne, builder of the engines, will analyze, refurbish and test-fire the engines to demonstrate their reusability under the direction of Jaime Brusse, senior propulsion engineer at Space Systems.

The recovery system's design is nearly complete and is being tested under the direction of Paul Rizzo, engineering specialist-major subcontracts. Four parachute tests were successfully completed in August. Three tests used single parachutes with a one-third-size thrust section mass simulator. The fourth test consisted of the Atlas E flight cluster of three parachutes with a full-size Atlas E mass simulator.

■ Julie Andrews

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System has ambitious designs for product development

Developing a product without proper supporting information can be like trying to assemble a youngster's birthday present without the instructions. It's easy for something to go wrong.

Land Systems Division has come up with a way to provide access to such information for product development teams throughout General Dynamics. It's called the Knowledge-Based Computer-Aided Designing Assistant System.

The system, developed by the division's artificial intelligence laboratory, captures, assimilates and disseminates the technical processes and expertise associated with product development and makes them available to designers.

This information complements concurrent engineering, which forms product development teams from many disciplines to ensure all aspects of a product's life cycle are addressed early in the design. The teams are often unable to exhaustively consider and evaluate the many design possibilities and trade-offs that are proposed because of time restrictions and human limitations. The Knowledge-Based Computer-Aided Designing Assistant will provide a single source of time-saving, detailed data for the product development team.

"The objective of the program is to develop and implement an intelligent design environment to support concurrent engineering," said Carl Hobson, Land Systems manager-design evaluation.

The first of two primary thrusts is developing expert systems for design issues such as harness routing, materials selection and joint fastening. Each expert system is

a computer program that will capture specific technical expertise for designing quality products. The expertise will come from sources such as manuals, handbooks and experts. One expert system under construction is the Mechanical Threaded Fastener Selector, which selects screws, nuts and washers to fasten parts.

The second thrust is developing a computer-based system to help construct and integrate expert systems with existing computer-aided engineering, design and manufacturing tools. This will provide access to any of the expert systems and design tools, even though these resources may reside on a variety of computers scattered throughout the division. It will also provide the necessary computer tools for building, testing, modifying and executing expert systems.

All exchanges of data among expert systems, the user, computer-aided design and data bases are conducted through the Expert Data Manager. It easily integrates these various computer resources.

Land Systems has constructed a prototype Knowledge-Based Computer-Aided Designing Assistant that combines the Mechanical Threaded Fastener with an off-the-shelf computer-aided design system and several data bases of standard fasteners, materials and drill sizes. The prototype allows the Mechanical Threaded Fastener to extract design data from the computer-aided design system; to query the data bases; to select appropriate fasteners for a joint; and to insert the selected fasteners' geometry back into the computer-aided design.

Land Systems has demonstrated its Knowledge-Based Computer-Aided Designing Assistant to the Army's

Tank-Automotive Command and Missile Command. The system is five years ahead of similar efforts, according to Jamie Florence, chief-manufacturing technology at Tank-Automotive Command. The system is likely to succeed because it is composed of small, narrowly focused pieces that can be delivered incrementally, according to John Montgomery, an engineer in Missile Command production engineering.

The prototype will require many improvements before the extended design team can use it effectively. Foremost is the construction of additional expert systems to address other aspects of product design and development. Many of these have already been constructed at either Land Systems or other General Dynamics divisions and are awaiting integration into the prototype. Other expert system applications are being developed.

Improvements include integrating additional computer resources needed to support concurrent engineering, such as data bases, expert systems, analysis tools, application programs and computer-aided design systems. A decision justifier will allow users to query the expert systems for explanations of design decisions and to record the explanations with the designs as the decisions are made. The Knowledge-Based Computer-Aided Designing Assistant will provide automatic electronic reports and audit-tracking capabilities, allowing in-progress review of product designs and tracking design history through critical decision points.

■ Jack Price

Duo delves into Quayle's space exploration suggestion box

From giant pogo sticks to proposals to slow down the moon's rotation, Vice President Dan Quayle's Space Exploration Initiative public outreach program has generated a wide range of ideas to return to the moon and continue to Mars and beyond.

Project Outreach was initiated last December to "cast a broad net" into all areas to gather new and innovative thinking on space exploration—from academia, industry, NASA and other government agencies, the national laboratories and the public.

Two Space Systems Division employees are involved. Howard Bonesteel, director-NASA advanced space transportation systems, and Paul Bialla, manager-NASA advanced programs, are helping to evaluate one source of industry-generated ideas as members of American Institute of Aeronautics and Astronautics subcommittees on Space Exploration Initiative architecture and transportation.

The institute received over 600 suggestions. But no dramatic breakthrough emerged—"no new way to defeat gravity, no 'silver bullet' found," Bonesteel said. The evaluators threw out any idea that defied the laws of physics.

"You always have an enormous mix when you ask for a general solicitation of ideas," said Bialla, who served on the space transportation committee. The committee evaluated about 30 proposals for earth-to-orbit transportation ranging from refinements of present systems to off-the-wall proposals such as the giant pogo stick.

"There has been so much work done on launch vehicle technology in the last 20 to 30 years that most reasonable ideas have emerged," Bialla said. "You can't expect something entirely revolutionary—in the movies, perhaps, but not in real life."

Studies have been done on laser propulsion, electromagnetic propulsion, even antimatter systems. But the "beam me up, Scotty" and "warp speed" of "Star Trek" are many years away, Bialla said.

On the drawing board are improvements to the shuttle as well as a new generation of launch vehicles known as the Advanced Launch System, both with the heavy-lift capability needed for the Space Exploration Initiative.

"The question is how to develop future launch vehicles today to operate in the 30-years-or-more Space Exploration Initiative time period," Bialla said. "We don't know yet what the Space Exploration Initiative is going to be and so the evaluation of transportation becomes more complex."

Industry consensus among the committee members is the technology exists to return to the moon and go to Mars. But the means and the timetable for doing so make

for a political and budgetary decision. The committee's recommendation would probably focus on an efficient fleet of systems based on some degree of modularity, Bialla said.

Bonesteel's architecture committee has analyzed proposals on the general structure of the program.

"Industry feels that the Space Exploration Initiative should be a framework and catalyst for certain desired benefits, not just a destination," said Bonesteel. "For example, if the desired benefit is human exploration of

space, the program structure will be different than if we rely totally on robotics. Industry also feels that the program must be supported by the American public in order to be sustained and must be perceived as affordable."

At the end of the year, the committee reports, together with those from other sources, will be funneled to the Stafford Commission. The commission will recommend competing architectures that will help to define the ultimate direction of the Space Exploration Initiative.

■ Julie Andrews



Paul Bialla (left) and Howard Bonesteel are helping shape the Space Exploration Initiative.

General Dynamics flashback



The RB-1 racer is shown in a painting by Fort Worth Division's Bob Cunningham.

Dayton-Wright's RB racer: 1920s plane with 1990s standard features

The little airplane parked at the Villesauvage Aerodrome near Estampes, France, in September 1920, drew crowds of curious aviation enthusiasts. They had never seen anything like it.

Just two years after the end of World War I—a war in which pilots flew fabric-covered biplanes held together with glue and wire and sporting open cockpits and fixed landing gear—this aircraft had a single wing, retractable landing gear, no visible struts or bracing wires and a completely enclosed cockpit. Slim, sleek and shiny silver, the plane stood in a deep-chested bulldog stance on tubular steel legs.

This was high-tech, circa 1920.

The Dayton-Wright Co., the largest U.S. manufacturer of military aircraft in World War I and an ancestor of Convair Division, built the aircraft as a high-performance racer and entered it in the James Gordon Bennett Aviation Cup at Estampes. One of the most prestigious aviation events of the era, the Gordon Bennett Cup drew 14 competitors from France, Italy, England and the United States. They flew one at a time, one attempt against the clock on a 300-kilometer course.

All the entrants were biplanes, except for Dayton-Wright's aircraft, called the RB-1 after the company's chief test pilot, Howard Rinehart, and principal designer, Milton Baumann. The RB-1's wing was completely smooth on the bottom and cantilevered off the fuselage. A crank that stuck through the pilot's instrument panel turned a worm gear that retracted or extended the landing gear and activated a variable camber wing. With wheels down, the wing's leading and trailing edge flaps were deflected down to provide a highly cambered, high-lift airfoil for takeoffs and landings. When airborne, the flaps came up with the wheels to create a thin, straight, high-speed airfoil.

The RB-1 included many other futuristic features. The wing was the first to use an exotic, lightweight wood called "balsa." The construction technique was the grandfather of today's honeycomb sandwich structure, using a solid balsa core between the wing's front and rear spars. The flaps had only a single spar with the balsa forming the shape. These components were skinned with thin plywood, covered with fabric and lacquered and sanded to a mirror finish. The trailing edge flaps also acted differentially as ailerons, a system that wouldn't be seen again for many years.

Rinehart sat in a cockpit that was buried behind the wing and offered no forward vision. To see in front of him for takeoffs and landings, Rinehart pushed his

head against a spring-loaded side window that opened outward to form a windshield.

Competitors and spectators quickly discovered that the RB-1 was built for speed. Rinehart had to throttle back on trial flights at Estampes because the combination of a small vertical tail and deep forward fuselage made the airplane weave. Still, Rinehart impressed the crowd with a lap time of 165 mph. After the trials, Dayton-Wright added small vertical tails to the tips of the horizontal fins to provide more directional stability and allow Rinehart to apply full throttle.

Whether the fix would have worked will never be known. On race day, Sept. 28, Rinehart was airborne for only a few minutes when he had to land. One of the RB-1's rudder cables had broken, Rinehart said, preventing him from turning onto the course. No attempt was made to repair the plane. Although the rudder cable was a common part that cost perhaps less than a dollar, the opportunity to prove the RB-1's concepts was lost. A Frenchman won the race with an average speed of 168.5 mph.

There is no record that the RB-1 raced again. Some elements of the design found their way into the military, with little success, as the PS-1 pursuit plane. In June 1923, Dayton-Wright sold its designs, manufacturing rights and production equipment to a new company called Consolidated Aircraft—the forerunner of Convair.

However, the RB-1 survived and is displayed at the Henry Ford Museum in Greenfield Village, Mich. What would have been the plane's effect on aircraft design had it won the James Gordon Bennett Cup? Maybe nothing. It was so far advanced that it was considered a curiosity.

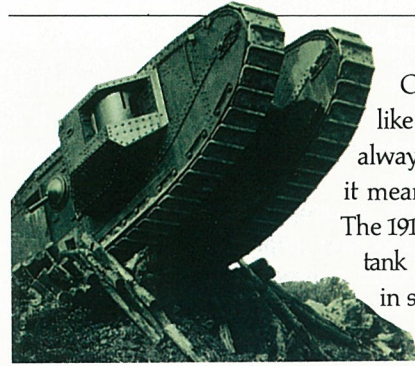
But the vision of the RB-1's designers can be measured by how long it took before some of the RB-1's elements became standard features on aircraft. The last of the open-cockpit, fixed-wheel biplane fighters did not disappear for 20 years. Variable-camber wings did not reappear until the 1950s and are used today on many aircraft, including General Dynamics F-111s and F-16 Fighting Falcons.

The fact that all the technical innovations incorporated into the RB-1 have come into common use proves the vision and genius of Dayton-Wright's pioneers. They lost the battle at Estampes. Their victories came later.

■ Bob Cunningham

(Bob Cunningham is a noted aviation artist at Fort Worth Division.)

UNLIKE SOME THINGS TODAY, IT'S BUILT LIKE A TANK.



Of course, "built like a tank" didn't always mean what it means today. The 1916 origins of the tank were shrouded in secrecy on purpose. Even the word "tank" was mysterious.

According to excited WWI reports, "Big Boy," one of the first American tanks, could knock down "huge trees."

The name came from the British during World War I. While they were developing the early machines, to keep their real purpose hidden, British officers referred to them as water tanks. The name stuck.

So did the first tanks. In mud. On slopes. In ditches.

Nevertheless, though slow and clumsy, they terrified enemy troops. One of the early British tanks was called "L'Enfant Terrible" by people in France.

By World War II, all the warring nations were building tanks.

American wartime industrial effort produced them in astonishing numbers: 6,653 Sherman tanks at the Detroit Arsenal in 1944 alone.

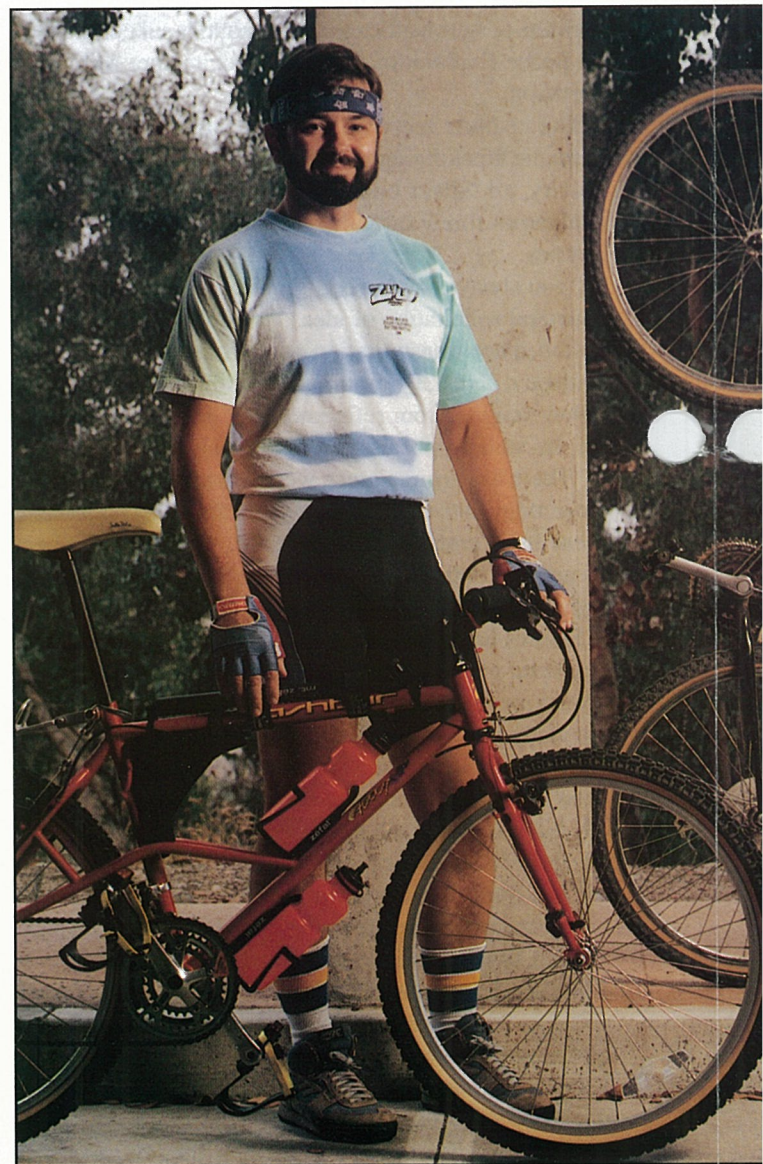


Yet the furious pace of production did nothing to slow down the pace of improvement. By the end of the war, the standard was the 43-ton Pershing.

By Korea, the M47 Patton.

In 1960, the first M60 was delivered, marking the beginning of the longest tank production run in U.S. history. Our company built redesigned and refined M60s, packed

General George S. Patton, America's most famous armor commander of World War II, seen here leading his troops in Italy.





with solid-state thermal and laser technology, for the Army until 1984, and for American allies until 1987.

But in the early 1970s, work had begun on a brand new tank of such expanded capabilities, experts called it not an improvement, but a reinvention.

It was the M1 Abrams.

The first generation M1 was delivered in February 1980. The second generation, the M1A1, in August of 1985.

For Abrams designers, the highest priority was the protection of the crew. Not only from conventional, but also from chemical, biological, and even nuclear contamination.

In day or night, in snow or desert sand, M1 technology exceeds the abilities of competitive tanks. Both in effectiveness and reliability.

The 65-ton Abrams can accelerate from a standing start faster than many small cars. For it, a nine-foot trench



Tanks passed in review for President Roosevelt as he inspected U.S. forces in French Morocco during the desert campaign of 1943.

is no obstacle. Nor is a 60% grade.

Soon the third generation Abrams, the M1A2, will begin tracking off the world's most highly roboticized tank production line.

Yet, even the M1A2 will not be the last word. Technological evolution is a constant force at General Dynamics, and our engineers are working to give American tank crews ever faster, stronger, better equipment.

One thing will be the same.
We will build them to be the best.

GENERAL DYNAMICS
A Strong Company For A Strong Country



TIM WHITEHOUSE

San Diego divisions cope with car crunch

A San Diego city ordinance aimed at exterminating traffic jams has General Dynamics divisions seeking ways to comply.

The Traffic Demand Management program took effect at the beginning of the year to reduce the drive-alone rate to work sites in San Diego. The ordinance cuts the drive-alone rate to 85 percent next year and reaches 55 percent by 1995. The law calls for economic and administrative penalties for companies that fail to meet annual targets.

"We are looking at a variety of ways to support and promote ride-sharing and other alternate forms of commuting to meet the targets," said Barbara McDonald, one of four Traffic Demand Management coordinators. "If present trends continue, San Diego's freeway congestion will continue to increase with our population growth. We're currently the seventh-worst city for air pollution in the country. We want to do our part to alleviate this problem."

Joining McDonald are her Traffic Demand Management counterparts Nancy Kimerly at Space Systems, Ed Langmaid at Electronics and Pat Gayton at Data Systems-Western Center. They have a big challenge. Employees have many valid reasons for driving alone, ranging from child-care pickups, after-work commitments and overtime to inadequate municipal transit and to simply wanting to be alone.

The coordinators' first milestone was to have all company employees complete a transportation survey. The survey data established an employee drive-alone rate for the nine company work sites in San Diego and helped the

coordinators identify the best opportunities for employee incentives.

The coordinators have already established preferred parking areas for car-poolers—no small fringe benefit given the huge parking lots at most of the San Diego facilities. The coordinators will continue to work closely with the San Diego transit authority and are installing Traffic Demand Management information centers in all plant locations.

Some San Diego employees are already exceptions to the drive-alone syndrome. Jackie Ellis, staff secretary at Space Systems, has car-pooled for nine years. When preferred parking arrived, she and her group were first in line for space No. 1.

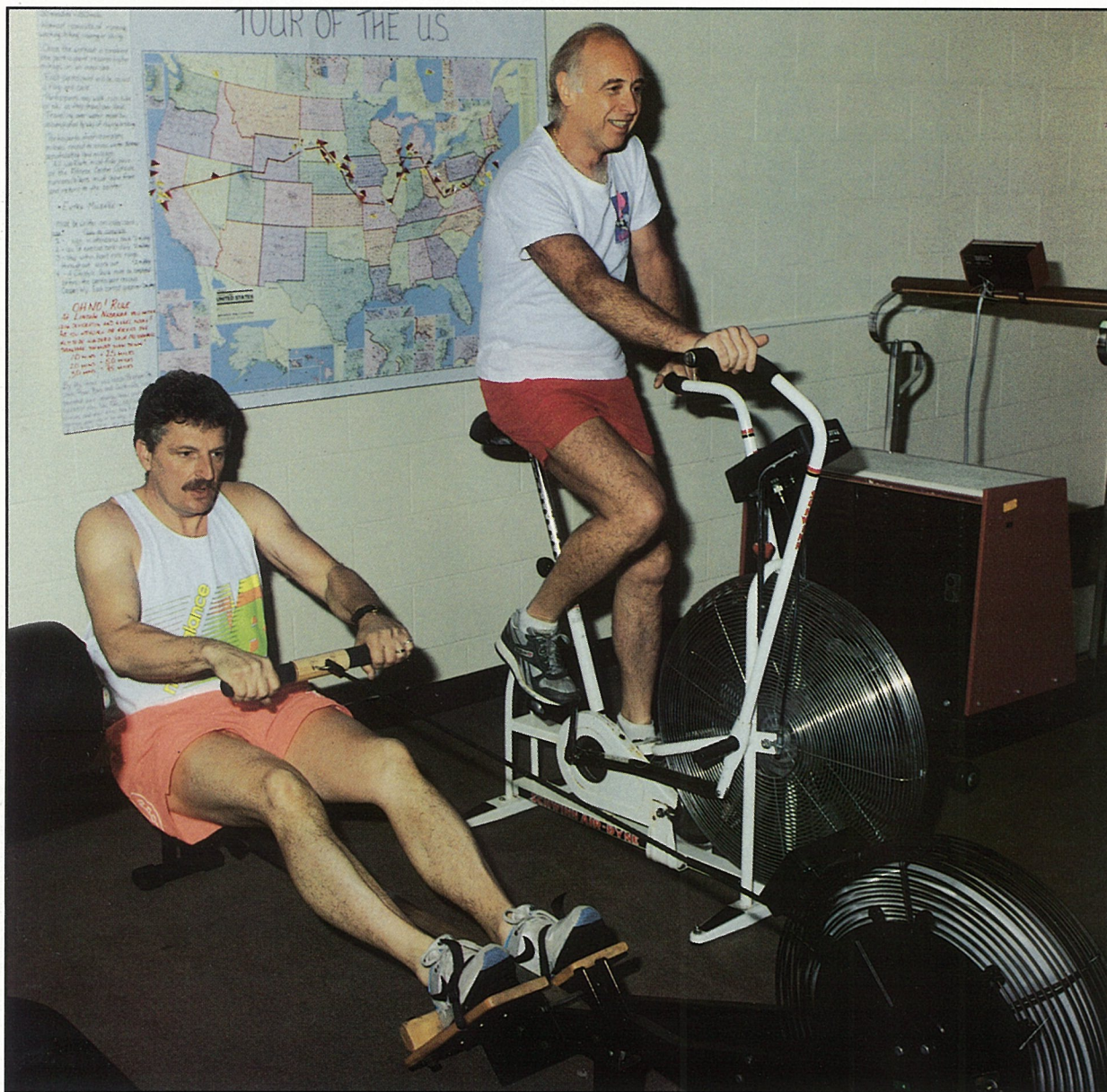
Rick Wilson, a graphic artist at Space Systems, rides his bicycle 20 miles each way accompanied by co-worker Chris Galvan, who began riding his bike the day he filled out the transportation survey. Steve Harbater, a Space Systems engineering specialist, rides the bus. That's a habit he carried from Seattle, where bus riding is not held in the disregard he says it is in San Diego.

Dick Ritz, security manager at Electronics, car-pools with four other colleagues from a community 50 miles north of San Diego. With that kind of weekly mileage, he and his mates enjoy substantial savings. Dan Clark, a Convair maintenance worker, has operated a vanpool from east San Diego County for 10 years.

Convincing die-hard drive-aloners to try alternative ways of commuting will rest on education, cooperation and the examples set by employees like these who have given up the automobile love affair for more meaningful benefits—and in so doing are helping the environment.

■ Julie Andrews

◀ Rick Wilson (left) and Chris Galvan display their modes of transportation.



Steve Olmstead (left) and Larry Hill exercise their way across the United States at Electric Boat's Cardio-Fitness Center.

U.S. 'tour' is an exercise in fitness

A map of the United States at Electric Boat Division's Cardio-Fitness Center sports brightly colored flags trailing from Groton, Conn., to San Francisco. The map is a tribute to nearly 70 committed employees who exercised their way across the nation as part of the division's contest to promote fitness.

"We wanted to do something to help motivate people to stick to a regular exercise program and encourage more participants to come in to the center to use the equipment," said Donna Kay, director of the Cardio-Fitness Center.

The contest began Aug. 8. The first winners were named Sept. 7 after 3,500 "miles" of biking, walking, running, rowing or skiing.

"We counted a period of time spent exercising as a certain distance," said Jody Wilkins, exercise physiologist. "For instance, 20 minutes counted as 100 miles. This held true most of the way across the map, except for a length of 1,000 miles in the middle when we cut the ratio in half."

The 1,000-mile stretch, called the "Oh, No! Rule," began when contestants reached Lincoln, Neb. There, they automatically developed dehydration and a knee injury. Their performance declined as they approached the Rockies. Their strength and rate returned to normal when they arrived in Brigham City, Utah.

"The contest increased the sense of camaraderie and everyone had fun with it," Kay said.

Overall winner Steve Olmstead, a supervisor in non-destructive testing, said he likes competition and finds that exercise relieves stress. A member of the division's fitness center for two years, Olmstead usually comes in daily for an hour of cardiovascular activity. "When I first began exercising, I could do about five minutes on the rower," he said. "During the contest, there was one day when I rowed continuously for an entire hour."

Olmstead received a first-place prize of an exercise watch, which he says he gave to his son to take to college.

Mike Ehrlich, senior engineer, was second and Greg Smith, engineer, finished third overall.

Engineering Supervisor Larry Hill won in the over-50 age group. Hill normally spends four days a week in the fitness center and uses all the equipment. "Aerobic fitness is my goal," he said. "I believe in fitness and it helps keep the blood pressure down."

"Most of the contestants really felt this program helped to keep them exercising and we're excited that it went so well," Kay said. "Some people liked it so much that they've decided to turn around and exercise back across the country to the East Coast."

■ Graham Gavert

Data link speeds spares, saves money

The Fort Worth and Electronics divisions have established a computer link that allows Electronics employees to input certain data directly into a parts provisioning data base at Fort Worth. The link saves both divisions time and money in supporting the Electronics-manufactured test stations called F-16 Avionics Intermediate Shops.

The link joins two previously incompatible systems and allows instantaneous updating of Fort Worth's Provisioning and Order Management System, which helps supply various F-16 support requirements.

The on-line system will greatly improve Fort Worth's ability to supply parts, said Paul Proctor, chief of spares provisioning.

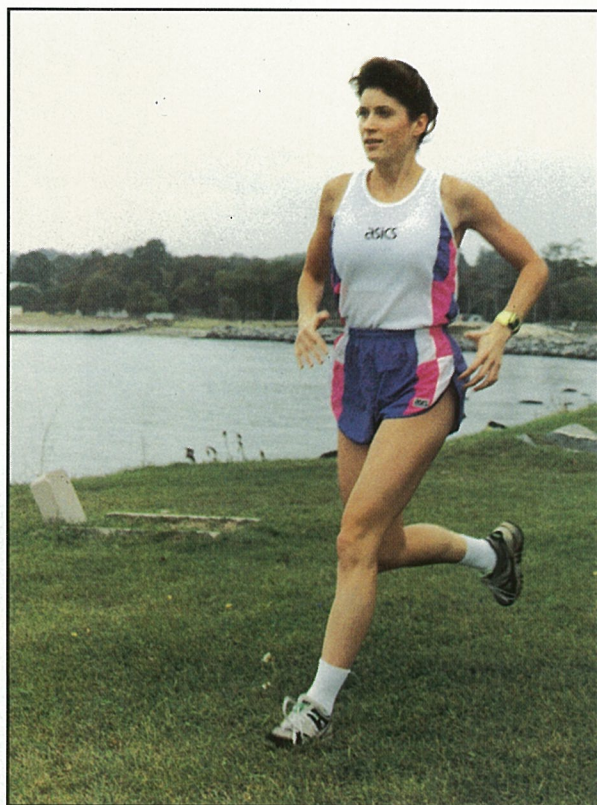
Electronics personnel had generated work sheets and

punch cards manually to create a provisioning parts list for Avionics Intermediate Shop equipment. The finished list was mailed to Fort Worth after a lengthy process of entering and verifying data.

The link is already saving considerable paper and effort at Electronics and Fort Worth. "In the future, a goal of total electronic provisioning between Fort Worth and the Air Force's Ogden Air Logistics Center in Utah may be achieved," Proctor said.

Starting the system required extensive interdivisional coordination by Fort Worth logistics data requirements employees Ken Bourne and Keith Spell. Shelley Adamie of Data Systems Division-Central Center did most of the 200 hours of programming required to establish the link.

■ Joe Stout



ART AVERY

Having a great time. Donna Kay, director of Electric Boat Division's Cardio-Fitness Center, posted the second-best time in her age group at the recent World Triathlon Championships in Orlando, Fla. Kay, shown training along the Thames River in Groton, Conn., competed in the 25-29 age group. Her time for the event, which consisted of a 1.5-kilometer swim, a 40-kilometer bike race and a 10-kilometer run, was 2 hours 16 minutes 3 seconds, two seconds behind the winner. Kay qualified by winning in her age group at the Triathlon Federation National Championships. She also finished second in her age group at the U.S. Triathlon Series Bud Light National Championships in late October. Her 1991 goal: "I'd like to compete in the Hawaii Ironman Triathlon, which finishes with a 26.2-mile run," she said. "That'll take a lot of training to get my body ready. I'll be happy just to complete the race."

M1A2 leaves lasting impression on head of Soviet military

The M1A2 Abrams tank turned the head of the Soviet Union's highest ranking military officer during a recent visit to Land Systems Division.

Gen. Mikhail A. Moiseyev, the first deputy minister of defense and chief of the general staff of the Soviet Union, witnessed the sophisticated improvements that make the M1A2 even more formidable than its M1A1 predecessor. The M1A2 is the next generation of tank the company will begin producing in 1992.

"Our stop at the General Dynamics Land Systems was a highlight of General Moiseyev's week in the United States," wrote Gen. Colin L. Powell, chairman of the Joint Chiefs of Staff and Moiseyev's host, in a letter to Land Systems Vice President and General Manager Robert W. Truxell. "He was clearly impressed with both the quality of the equipment and the quality of your people. Traditionally, as you well know, the Soviets are quite capable at developing their tank programs, but General Moiseyev was still talking about the M1A2 days after he saw it."

"I am deeply indebted to you, Gordon England (Land Systems vice president-research and engineering), and Gary Diaz (Land Systems director-Abrams engineering programs), as well as the people at TACOM (Army Tank-Automotive Command), for their invaluable help as this program was put together. Please pass on my appreciation to everyone."

Following an M1A2 briefing, the visitors toured two systems integration laboratories and inspected a prototype M1A2. Moiseyev, a former tanker, climbed inside the tank and saw its sophisticated technology. "He was impressed with the technology, especially the computer and software technologies that make possible improved communications between and among tank crews and command authorities," England said.

The stop at Land Systems marked the halfway point in a six-day, six-city tour.

It was Moiseyev's first visit to the United States.

Value Engineering proves its worth at Fort Worth Division

It's saved the government more than \$117 million on the F-16 program. It's redesigned parts to make them cheaper and more effective. It's become a model for industry.

It's Fort Worth Division's Value Engineering program. The program seeks cost and quality improvements.

The typical Value Engineering project results in a redesigned part that is less expensive than the original but performs as well or better. The process often results in a customer-approved change in contract requirements or specifications.

Value Engineering is marking its 30th anniversary. Thirty-five Fort Worth employees recently completed the program's 100th seminar. The milestone was observed with a brief graduation ceremony featuring remarks by Herbert F. Rogers, president and chief operating officer, and the return of three former employees who founded the division's original Value Engineering program in 1960. The Society of American Value Engineers, which certifies the seminars, was represented by Arthur Schwartz, president of the Dallas/Fort Worth chapter.

Value Engineering is "one initiative that got off the ground," Rogers said. Value Engineering will continue to be important to the company as one of many existing programs that come under the total quality umbrella, he added.

"The total dollar value of savings through Value Engineering is impressive... but I would hope that there is a greater value to the program," Rogers said. "The graduates will leave this course with the idea that it is easy to make an improvement, if we just tackle the idea that an improvement can be made."

"What you did is learn a process," he told the students.

Seminars are held periodically to teach employees how to apply proven Value Engineering techniques. The

Value Engineering process includes steps that begin with defining the function of the part being studied. Cost-adding features that don't significantly contribute to the function are usually eliminated.

More than 4,000 Fort Worth employees have been trained in Value Engineering techniques since 1960.

Fort Worth's seminars are 40-hour workshops. Students learn the techniques of Value Engineering by working on real projects in multidisciplinary teams. Participants in the 100th seminar completed six projects related to various F-16 parts, including access covers, structural components and a cooling air supply duct. A total savings of \$5.9 million could result from their work, pending Air Force approval of the new designs.

Participants in the first Value Engineering class in 1960 proposed several design changes for the B-58 Hustler bomber, saving more than \$82,000, or nearly \$400,000 in 1990 dollars. Six students out of 42 from the first seminar are still employed at Fort Worth.

Air Force and supplier representatives have also attended Fort Worth's Value Engineering seminars, which are recognized as among the best in the nation.

The Department of Defense and the Air Force twice have recognized Fort Worth as Value Engineering Contractor of the Year.

Fort Worth retirees C.W. "Smokey" Doyle, Rand Creasy and John Shaffer, founders of the Value Engineering program, attended the 100th graduation. Doyle recalled meeting with then-Secretary of Defense Robert McNamara to explain the benefits of Value Engineering in the early 1960s.

The General Dynamics program has been acclaimed for its success throughout its history, Doyle said. "I'm thankful that our management mandated Value Engineering 100 percent," he added.

■ Joe Stout



From the B-58 Hustler (top) to the F-16 Fighting Falcon, Value Engineering has saved the government well over \$100 million.

What's for lunch? The Info Exchange

Engineers at Space Systems Division have been digesting more than food during selected lunch hours this past year. A grass-roots communication group called the Engineering Information Exchange is wrapping up its first year of weekly brown-bag roundtables and monthly noontime seminars covering the space launch business.

The exchange has presented a look at Space Systems' Atlas and Centaur, the payloads they will be launching, vehicle subsystems, launch business issues and domestic and foreign competition.

Based on attendance and interest, the exchange is "an outstanding success," according to Vice President-Research and Engineering Bob DiNal. Many of the sessions have been standing-room only.

"Access to information is important in how I do my job," said Terri Charles, a thermal control engineer. Charles, along with Ann Fauni, program office engineer, and Debra Kimberling, structural engineer, are the founding members of the exchange.

Charles was hired at Space Systems a year ago. "I was excited about working for a big rocket company, but wanted more information at the technical level about our industry," she said. Fauni and Kimberling agreed.

Kimberling brought up the information exchange during one of DiNal's regular employee meetings. "Employees need access to basic information on our launch vehicle and how all functional groups contribute to a launch success," Kimberling said. DiNal supported the idea. On their own time, the three founders planned a schedule of topics to be presented by division experts.

"Our immediate goal was to involve people from a

cross-section of functional groups who are interested in exchanging information," Kimberling said. The exchange group involves charter members Rob Rosenstein, engineering administration; Ben Mathews, thermal control; Merri Anne Stowe, systems engineering; Mona Younes, ground fluid systems; Ray Louie, structures design engineering; Andy Learn, systems engineering; and Jim Valk, business development.

One of the highlights has been the "Sizing up the Competition" monthly meetings covering competitors such as McDonnell Douglas, Martin Marietta, Ariane-space, the Chinese, the Soviets and the Japanese.

"We can learn from the competition's successes and failures," Fauni said. "The exchange has also provided the means for more senior employees to share the wealth of information they have accumulated."

The exchange supports the division's total quality management initiatives besides answering some of the concerns emerging from the 1989 employee survey over lack of communication.

"TQM requires us to understand what our customer needs from us as well as to improve our operating environment," Fauni said. "The information exchange provides a means to enhance communication in order to improve our way of doing business."

Added DiNal: "I believe that to get outstanding support from an organization, it must understand the challenges. Take the 'Sizing up the Competition' series. Everyone who attended now understands the intense competition we face."

■ Julie Andrews

Thornton Quarry goes to bat for worker's son in Pan Am baseball

Employees from Material Service Corp.'s Thornton Quarry pitched in with \$500 in contributions, matched by the company, to help send the son of a Thornton worker to the recent Pan American Junior Baseball Championships in São Paulo, Brazil.

Angel Santiago's son, Angel Jr., is a 15-year-old center fielder who was one of 18 players picked for the United States team. He started in six of seven games and delivered two bases-loaded doubles to help the U.S. team finish second.

Santiago hit fifth or sixth in the U.S. batting order.

The youngster thanked his father's employer and co-workers for helping him with traveling expenses and added, "I might never get the chance to play like this again. I'll remember it for the rest of my life."

Santiago had solid credentials for making the Pan American team. The *Chicago Sun-Times* listed him as a player to watch in its high school report and named him to its all-area summer league team. Santiago batted .444, scored 16 runs and drove in 20 runs in 20 games for his summer league team.

Santiago's goal is to play at the collegiate level and perhaps beyond. The Pan American tournament reassured him that he could compete with almost anyone his age. "Now I know where I stand," said Santiago, who has been playing organized baseball since he was 5 years old. "Some of the guys have a little edge and some are a little under."

■ Peter Stamos

Applications available for 1991 scholarships

Applications are available for General Dynamics college scholarships. The company will award three \$5,000 scholarships to outstanding students with financial need. Two \$1,500 awards will be given to outstanding students without regard to financial need.

Eligible students must be children of General Dynamics employees and must be high school seniors planning to major in engineering, physics, mathematics, chemistry, computer science or business at an accredited four-year college or university. Awards to women and minorities will be given in proportion to the number of applicants.

All scholarships are renewable up to three years based on academic performance.

Brochures and applications can be obtained at all divisions and subsidiaries. Applications must be postmarked by Feb. 1 and sent to the program's administrator, the Citizens' Scholarship Foundation of America. General Dynamics will continue to support students who have received grants through the previous administrator, the National Merit Scholarship Corp.

Savings and stock investment plans

	Annual rate of return for the 12-month period ending:		
	Sept. 1988	Sept. 1989	Sept. 1990
Salaried			
Government bonds	8.4%	8.5%	8.9%
Diversified portfolio	(13.3)%	34.5%	(11.7)%
Fixed income	10.8%	10.4%	10.1%
Hourly			
Government bonds	8.7%	8.6%	9.0%
Diversified portfolio	(13.8)%	35.4%	(11.8)%
Fixed income	10.7%	10.4%	10.1%
GD stock closing price	\$50.50	\$58.12	\$23.62
() Denotes negative number			

Cessna releases its biggest product announcement

Cessna Aircraft Co. made what one company official called its "most significant product announcement" when it recently unveiled plans to produce the Citation X, which is designed to fly just under the speed of sound.

Cessna revealed the new business jet at last month's National Business Aircraft Association convention in

able to cruise at Mach .86 at 41,000 feet, enabling it to fly direct from Los Angeles to New York in approximately four hours or from New York to London in roughly 6 1/2 hours, according to Norris.

The aircraft also may be the most fuel-efficient business jet in terms of passenger miles flown per gallon. De-

The new aircraft expands to seven the number of models in the Citation family, the largest line of business jets any manufacturer has ever had. First flight is scheduled in March 1993, with deliveries beginning in June 1995.

The Grand Caravan, meanwhile, can be converted from a cargo plane to a passenger carrier in 20 minutes. It offers 340 cubic feet of cargo capacity and can carry 111 cubic feet more with an optional cargo pod installed under the fuselage.

"Our customers and prospects said they needed a larger version of the standard Caravan," Norris said. "Cessna has responded by producing what we believe is the most versatile utility aircraft available."

The aircraft can carry up to 14 passengers. In its 10-seat configuration, people have the same amount of room as first-class airline passengers.

Equipped with a 675-shaft-horsepower Pratt & Whitney PT6A-114A engine and an all-metal McCauley pro-



Left: A composite photo of a model shows the proposed Citation X. Below: Cessna's new Grand Caravan



New Orleans, where the company also introduced the Grand Caravan, newest member of the Caravan utility turboprop family. The Grand Caravan is the largest passenger/cargo single-engine turboprop in production today.

"The Citation X represents the most significant product announcement we've ever made," said Roy H. Norris, Cessna's senior vice president-marketing. "It firmly establishes Cessna as the leader in the development of business aircraft."

"We've been the business jet leader for a long time. With the Citation X we have established a new beachhead in our profession by introducing an aircraft that flies faster than any other commercial aircraft other than the SST."

The 10-passenger Citation X will have a maximum operating speed of Mach .90. The business jet will be

pending on use, it could save hundreds of thousands of dollars in fuel costs each year compared with other business jets flying similar missions at slower speeds, Norris added.

The newest Citation will have twin General Motors/Allison GMA-3007A turbofan engines, each generating 6,000 pounds of thrust. With its advanced supercritical wing design, the aircraft will be able to climb direct to 41,000 feet in only 17 minutes and to 47,000 feet in about 30 minutes. It will be certified to fly at 51,000 feet.

Citation X's 633-cubic-foot cabin has all the amenities found in much more expensive aircraft. It features such standard or optional equipment as an executive corner office, complete with telefax, desk and swivel chair; a formal galley with microwave oven; a large lavatory; and a three-channel video system. The Citation X's equipped price is \$11.85 million, plus interior.

pellier, the aircraft features improved climb performance and cruise speed. Cruise speed of the Grand Caravan is 209 mph and its maximum range is 1,108 statute miles.

"We expect it to play well in the international marketplace because of its simplicity and high reliability," Norris said. "It should open a number of additional markets beyond the overnight express and utility freight markets that have been the fleet's stronghold until now."

The Caravan fleet of more than 400 aircraft has flown more than 500,000 hours while recording a dispatch reliability rate of 99 percent.

TQM CASE STUDIES

Data Systems concentrates on performance management

Data Systems Division used the 1989 employee survey to plan one of its first divisionwide total quality management projects, a critical process team addressing performance management at Data Systems' nationwide locations.

Critical process teams investigate high-level, cross-functional processes that critically impact an organization's operations or ability to meet customer requirements.

Sixty-seven percent of Data Systems employees expressed concerns about adequate correction of poor employee performance and related issues in their survey responses. Corporatewide, 63 percent of General Dynamics' employees said too little is being done to correct poor performance.

Ralph Kiger, Data Systems vice president-human resources, will act on recommendations. Ron Hollister, manager-training at Data Systems—Central Center in Fort Worth, was selected by the team to be its chairman.

In addition to Central Center and Data Systems' headquarters in St. Louis, team members represent the Eastern Center in Norwich, Conn.; the Western Center in San Diego; the Air Defense Systems site in Pomona, Calif.; and the Financial Services Center in Temecula, Calif.

Team members underwent total quality management training by a consultant firm, The Cumberland Group, in June. "Since then the team has been defining the process, getting input from the center direc-

tors and other sources, and developing an action plan," said Central Center's Ginger Eby, manager-data administration and a team member.

"In addition to the performance management process itself, the team must deal with the logistics of being spread across six locations, plus the process differences among those locations," Eby said.

The team defined performance management to include planning, coaching and feedback, correction and recognition, appraisal and merit compensation, and professional advancement and promotions.

"Because this scope is so broad, several related processes had to be ruled out of the team's agenda," Eby said. "Hiring and termination processes, transfers and career development planning may be topics for future teams."

Limited budgets, the wide separation of Data Systems' various locations and the natural reluctance of employees and managers to accept change may be obstacles to successful completion of the team's task, Hollister said. The team is seeking employee input and participation to help overcome these challenges.

Data Systems employees will be interviewed and are being asked to submit comments and suggestions on the performance management process by contacting the team members. Printed total quality management forms are also being used for input.

The team plans to recommend improvements in mid-1991 and put them in place by the end of the year.

Other team members are Phil Gilberto and Joe

Schechter at Eastern Center; Ann Densmore, Rich Gaeta and Dave Birdsall at Western Center; Ellen Ploeger at Pomona; Bill Bockstahler at Temecula; and Phil Paul and Bob DiMaria in St. Louis.

■ Joe Stout

o o o

It's showtime for TQM

Data Systems Division-Central Center's product software group has devised a total quality management briefing with a different twist.

The group's "Q+" team created and performs an innovative variety show to spread the total quality management message. The characters include "Vanna," "Rocky" and "Duke Skywalker." The script encourages audience participation and also gives the work group leader an opportunity to express his or her personal commitment to total quality management.

"It turns out just a little bit different each time it is presented," said Michael Ackleson, a member of the team. "The tactics of humor and originality are used to illustrate that GD culture can be changed, even in so small a way as to turn a potentially dry briefing into an entertaining—but still informative—event."

More than 1,200 employees have seen the presentation. Briefings are scheduled for another 900. The script and a videotape of the routine have been provided to Data Systems—Western Center.

◆◆◆ Season's greetings ◆◆◆

Dear Fellow Employees:

In these most uncertain times, one thing is certain: The years ahead will not be easy. Uncontrollable world events will continue to influence our business tremendously. How we react to this circumstance and how we manage those activities that are controllable by us will determine the well-being of our business and our company.

As we approach the holiday season, let us think about what's most important: our families, our beliefs and our way of life. Let's be thankful for all that we have and be helpful to those who do not have as much. This is the true spirit of the holiday season.

As you know, my tour of duty as your chairman and chief executive officer is coming to the end. On Jan. 1,

the task of guiding General Dynamics falls into the very capable hands of my successor, Bill Anders.

I have enjoyed my 5½ years with you. It has been hard work with both "ups" and "downs." It has been fun. I have made many friends. I'm glad I came.

I thank you for your wonderful support. Please continue to provide that support to Bill Anders. And please accept my warmest wishes for the holidays and the coming new year.

SPace

Stanley C. Pace
Chairman and Chief Executive Officer



Jingle bears. San Diego employees who coordinate a project to grant gift wishes from needy children use teddy bears as the symbols of the project.

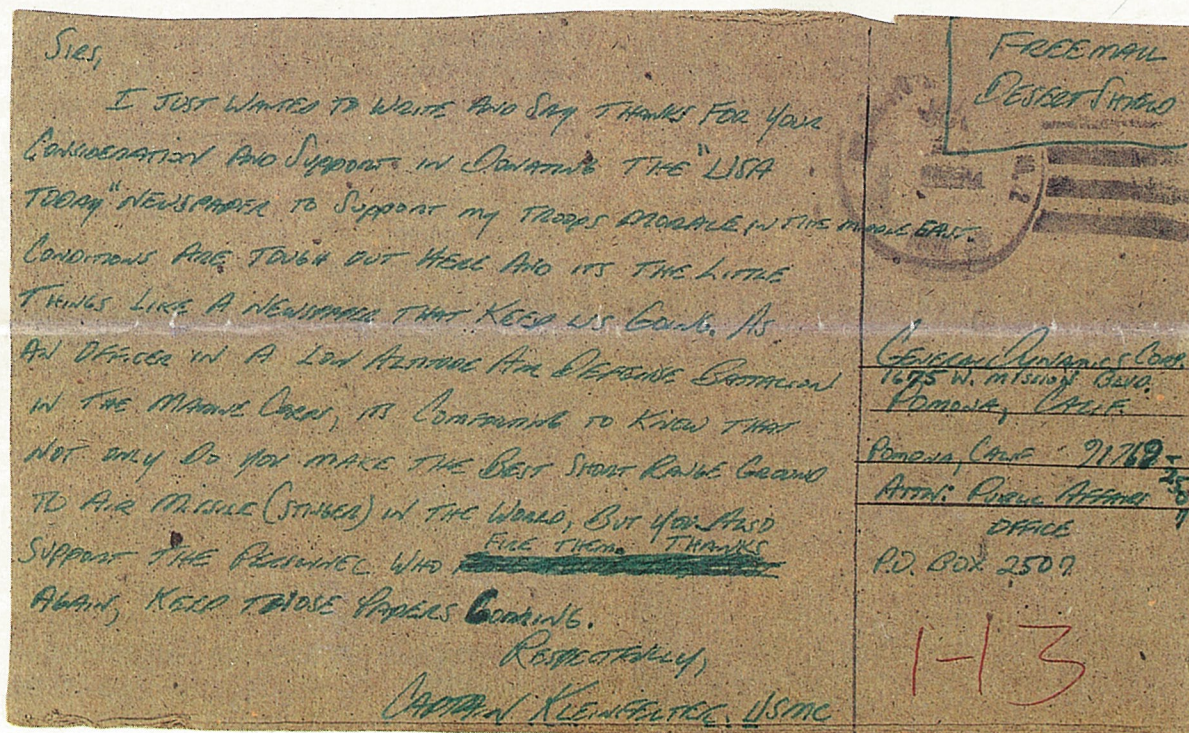
See story on pages 4 and 5.

GENERAL DYNAMICS

World

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A Marine sent a thank-you note on unusual stationery. The other side of the "letter" is shown below.

General Dynamics, *USA TODAY* begin 'newslift' to U.S. troops

Thanks to an exclusive arrangement between General Dynamics and *USA TODAY*, thousands of copies of the newspaper are being distributed each day to American forces participating in Operation Desert Shield.

The idea for the "newslift" came to Winston Gifford, corporate director-contributions, after the media reported the boredom and isolation besetting American servicemen and women sent suddenly to the desert. A confessed news junkie, Gifford thought that making a national publication available to the troops would be a good way for General Dynamics to help their morale.

Gifford settled on *USA TODAY* because it bills itself as "America's newspaper," features daily stories from every state in the country, and covers world news, the nation, sports, weather and entertainment. He contacted Larry Lindquist, senior vice president-circulation at *USA*

TODAY. Coincidentally, Lindquist had begun talks with the U.S. Central Command about a similar idea.

Gifford worked out a deal for General Dynamics to purchase a number of papers at cost. The publishers would deliver the papers to Dover Air Force Base, Del. for quick shipment to Saudi Arabia. *USA TODAY* and the military worked out distribution to troops in the field, and General Dynamics obtained approval from the Saudi government.

The "newslift" began on Oct. 12. Initially, 12,000 copies – each carrying a sticker that reads "News from home, courtesy of General Dynamics and *USA TODAY*" – are going daily to Desert Shield forces.

Gifford says, "The fact that we could act quickly and decisively to support our American service people in Saudi Arabia seems to me to define our corporate slogan, 'A Strong Company For A Strong Country.'"



Atlas booster becomes AT&T's long-distance carrier for TELSTAR

Commercial Launch Services Inc. will use its Atlas IIAS vehicle to launch two TELSTAR 4 communications satellites for American Telephone & Telegraph Co. The recent contract calls for launches in 1993 and '94.

The Atlas IIAS, the most powerful member of the Atlas family of launch vehicles, will boost the TELSTAR 4 satellites from Launch Complex 36B at Cape Canaveral Air Force Station, Fla. The Atlas IIAS is capable of lifting up to 7,700 pounds into geosynchronous transfer orbit.

Atlas has successfully placed into orbit four of AT&T's Comstar series of communications satellites.

The TELSTAR 4 communications satellite system is being built by the General Electric Astro-Space Division to unique AT&T Bell Laboratories specifications.

The new TELSTAR satellites will operate in the C- and Ku-band radio frequencies, offering AT&T customers special features and capabilities. TELSTAR 4 will increase AT&T's ability to serve new and growing communications markets, such as very small aperture terminal data, satellite news-gathering and business television.

The new system will replace AT&T's TELSTAR 3, which provides public, government and business private lines marketed as the SKYNET(R) family of services.

This latest contract increases Commercial Launch Services orders to 26. Space Systems Division builds the Atlas I, II, IIA and IIAS launch vehicles and is under contract to build and launch 10 Atlas II rockets for the Air Force.



Atlas will lift two AT&T payloads into orbit.

Atlas launch streak reaches 20

Space Systems Division's Atlas booster extended its string of consecutive successful launches from Vandenberg Air Force Base, Calif., to 20 when it lifted a defense meteorological satellite into orbit Dec. 1. The streak is the world's longest for successful liftoffs.

The booster used for the launch was originally manufactured and delivered to the Air Force as an intercontinental ballistic missile in 1961. It was decommissioned and stored in 1964. It was refurbished in 1983.

A total of 273 Atlas missions have flown from Vandenberg since the first launch in September 1959.

Current & Comment

Merry Missiletow and Happy Nuclear

This is the time of year when we in the defense industry find ourselves at a distinct marketing disadvantage. Others — those who work in more consumer-oriented businesses — use holiday ads, billboards and even greeting cards to tout their products, to woo customers and, presumably, even get a tax break next April.

Who among us, for instance, cannot recall a soft drink-swilling or cigarette-smoking Santa relaxing after a harrying trip down the chimney? Computer and car manufacturers toast the season with high-gloss pictures of their products wrapped in radiant red ribbons. We see bankers and investment services dispatching greeting cards that portray a smiling Santa decking the family Christmas tree with IRAs, CDs and platinum-coated credit cards. No doubt, too, it's only a matter of time before some aggressive (but irreverent) marketer photographs three of his top salesmen wearing crowns and robes and laying down calculators, garage door openers or microwaves before a smiling, reclining American consumer.

But not us. The defense industry is an unpopular guest at most holiday parties. And its products almost always have to be checked at the door.

It is unrealistic, then, to think that we might design seasonal greeting cards around some of our best sellers, such as a head-on close-up of a red-and-green Tomahawk cruise missile arriving on target, centered below the traditional line of "across the miles." Or Santa waving cheerily from the hatch of an M1 tank as it rumbles over a nursery of blue spruce. Or even a bewitched nuclear attack sub garnished in garlands of greenery as it rests at its berth in Holy Loch.

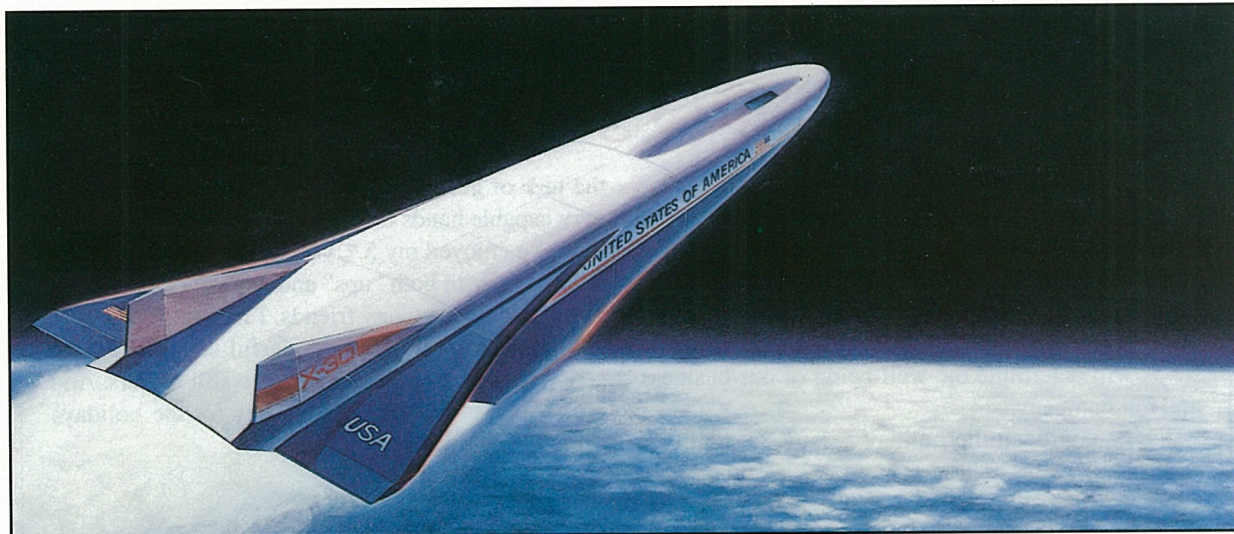
No, definitely not.

Nevertheless, our business does spin off some unique holiday benefits. For example, since the implementation of our new ethics program some years back, I've regularly invoked CPP 23-107 among family members each Christmas season. Since this permits exchange of only those gifts that are "trivial in value, mass produced, and not intended to evoke any form of reciprocation," personal savings have been significant. The problem of what to do with all those ballpoint pens and calendars is another story.

Other fringes accompany the ethics program. With the steadily improving image of our company there is also increased social acceptance among neighbors and community. No longer must we respond to questions about our occupation with a mumbled "da fence business," thereby inviting further interrogation about chain links, split rails or western red cedar. Today we are free to mingle inconspicuously at eggnog parties and church services, just like real people who earn their living selling junk bonds or hot tubs.

So there is much to be grateful for at this time of good will toward mankind. Never mind that we can't expect a seasonal retail run on our product line to offset what hasn't been the greatest year for the bottom line. It's still the season to be jolly. So do it!

■ Peter K. Connolly



NASP CONTRACTOR TEAM

An artist's concept shows the joint configuration being designed for the X-30 vehicle by the contractor team. Details of the concept will be refined during the next few months. The lifting body approach incorporates the relatively small wing area used in the original General Dynamics design, along with twin vertical stabilizers and other features from other team members' concepts.

A milestone year for NASP in '90

In the early 2000s when the X-30 research vehicle is making regular test flights from Edwards Air Force Base, Calif., 1990 will probably be remembered as an important year for the National Aero-Space Plane.

So predicted James R. Thompson, deputy administrator of NASA, in his keynote remarks at the recent International Aero-Space Planes Symposium in Orlando, Fla.

Significant progress was made in several aspects of the effort to build a vehicle that can take off like a conventional airplane and reach orbit. General Dynamics is one of five contractors teamed to research and construct the X-30 National Aero-Space Plane.

Perhaps most importantly in 1990, \$273 million was allocated for the program in the government's 1991 budget — just shy of the original request of \$277 million. The funding ensured continuation of the program.

The budget indicates Congress understands the importance of X-30-derived technologies to U.S. aerospace leadership in the 21st century, Thompson said. "We see this as an investment in the future," he said. "The technologies that we're talking about push far beyond a single aero-space plane or even a fleet of aero-space planes."

Thompson predicted the program will be funded at levels similar to fiscal 1991 for the next several years.

Another significant milestone was formation of the National Aero-Space Plane contractor team of General Dynamics, McDonnell Douglas, Rockwell, Rocketdyne and Pratt & Whitney. The companies' equitable teaming arrangement is unprecedented in the management of such a complex program, according to Thompson.

General Dynamics contributes two key members to

the contractor team's program office in Seal Beach, Calif.: Armand J. Chaput, who was selected as chief engineer, and Bob McGuffee, the newly named deputy director for program development. Both played key roles in General Dynamics' National Aero-Space Plane program during the past few years and now report organizationally to the national team.

The other achievements in 1990 were critical technical accomplishments that are beginning to provide answers to feasibility questions about single-stage-to-orbit flight. "The foundation has been laid," Thompson said. "The fundamental technologies are now in hand or soon will be."

Researchers throughout the nation recorded testing milestones related to computer-aided design, materials, control systems, fuel and other technical requirements. For example, Fort Worth completed fabrication of a large-scale carbon-carbon composite test article that subsequently passed temperature and structural stress testing simultaneously for the first time in the program.

About 3,000 engineers and scientists throughout the country are working on the X-30, according to Robert Barthelemy, director of the government program office at Wright-Patterson Air Force Base, Ohio.

President George Bush and Vice President Dan Quayle continue to be strong supporters, Thompson said. He also expressed confidence that the program will be successful: "I believe that some derivative of the NASP will eventually be our primary people carrier to space," he said. "The key to success is very clear ... continue the steady progress that has been demonstrated over the past year."

■ Joe Stout



TONY BREWER

General Dynamics Services Co. personnel check a Navy F-5 Tiger II adversary aircraft. Pilots flying the F-5, and F-16N Fighting Falcons in the background, adopt Soviet tactics in simulated combat to realistically train Navy flyers.

Aircraft support contract adds 200 jobs

Additional business for General Dynamics Services Co. will add more than 200 jobs and generate as much as \$120 million.

The revenue and additional employees result from the company winning the Navy Adversary/Strike Aircraft support competition. The contract continues company support for F-16N Fighting Falcon and F-5 Tiger II adversary aircraft at three naval air stations. The pact adds maintenance and logistics support for F-5s at Marine Corps Air Station Yuma, Ariz., and for a variety of air-

craft, including F/A-18 Hornets and F-14 Tomcats, at Naval Air Station Fallon, Nev.

General Dynamics Services Co. held the last Navy Adversary contract as a subcontractor to Fort Worth Division for the last four years. The work employed over 200 people. The additional business will more than double employment.

The contract is for one year with four one-year options. The potential value of the program is more than \$120 million.

GENERAL DYNAMICS World

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First steps taken to trim illiteracy

(This is the third in an occasional series on General Dynamics' employee diversity program.)

The literacy problems of a General Dynamics foreman went undetected for 15 years. But when he recently went through his division's transition center, he admitted after five interviews that he could not complete an application form or write a cover letter.

Helping those with similar problems is the goal of the Employee Diversity Task Force. Its work, including a recent videoconference to determine the extent of corporatewide illiteracy, has just begun. "But we're taking an important first step," said Roberta Baade, corporate director-human resources development.

Various divisions and subsidiaries have started literacy programs. The need is pressing. "There are 27 million people in the United States who are illiterate and 45 million more who are marginally competent," said Diana Schmidt, executive director of the Missouri chapter of Literacy Investment for Tomorrow.

The divisions' programs include tutoring sessions and English-as-a-second-language classes. Federal and state grants are helping. Land Systems' Transition Center recently received \$324,000 in federal funds for training and retraining. Electric Boat's Quonset Point facility was given more than \$44,000 for its Learning Center from Rhode Island's Workforce 2000 Council.

Transition Center workers at Land Systems estimate about 15 percent of the work force have literacy problems. "We find people with 20-25 years of experience have been hiding their deficiencies very well," said Pat Brown, who manages the center. "We are working with Private Industry Council representatives to assess workers with deficiencies and then put them into literacy programs. We're not only talking about blue-collar workers, but white-collar employees as well."

Space Systems officials have met with San Diego Literacy Network and Private Industry Council members.

The problem at Space Systems isn't necessarily with current employees, but with preparing for the incoming work force and helping illiterate and semiliterate laid-off employees find work, according to Nancy Kimerly, manager-human resources.

At Convair, the literacy problem is most apparent at the entry level and among hourly workers, according to Tom Crow, chief-human resources. "We don't know what the extent of those problems are, but we're testing at the ninth and 10th-grade levels to enable many hourly applicants to qualify for employment," Crow said. "If an applicant tests low, he is offered a less-skilled position."

Many long-time Convair employees also have successfully evaded screening. "They have memorized their jobs, but when they are switched to a new position, they cannot perform because they cannot read," Crow said.

Quonset Point's literacy center also deals with such problems. The center is in a renovated building housing a computer lab and a coordinator's office. Reading is taught and a math literacy program is being developed.

Cessna has two fully equipped classrooms and 60 volunteer tutors who test employees, then teach working and reading skills during off-duty hours. A ride in a Cessna plane is a reward for course completion.

At Fort Worth, "we have established a basic interdepartmental skills committee to improve literacy and math skills," said Charles MacNelly, human resources specialist. "We are looking at ways to identify those who need help. We know we have a problem, especially with a bilingual population."

Many of the basic skills programs at Fort Worth are being done at Tarrant County Junior College. The company is also funding an on-site math skills program. The interdepartmental skills committee is actively seeking to begin a reading program as well, according to Larry Tagrin, senior instructor/developer in the training and development department.

■ Myron Holtzman

GD again No. 1 in information systems

For the second consecutive year, General Dynamics has been rated the most effective user of information systems in the aerospace industry, according to a survey by *Computerworld* magazine.

The survey rated the best 100 information systems users among Fortune 500 companies. General Dynamics placed sixth overall.

The author of the article, Mitch Betts, wrote that General Dynamics' pursuit of total quality management principles played a major role in gaining the top spot among aerospace companies.

Betts wrote: "At St. Louis-based General Dynamics, TQM means building tank hatches with a 100 percent seal and building information systems that exactly meet the requirements of the business units. ... It means making continuous process improvements to ensure that things are done right the first time."

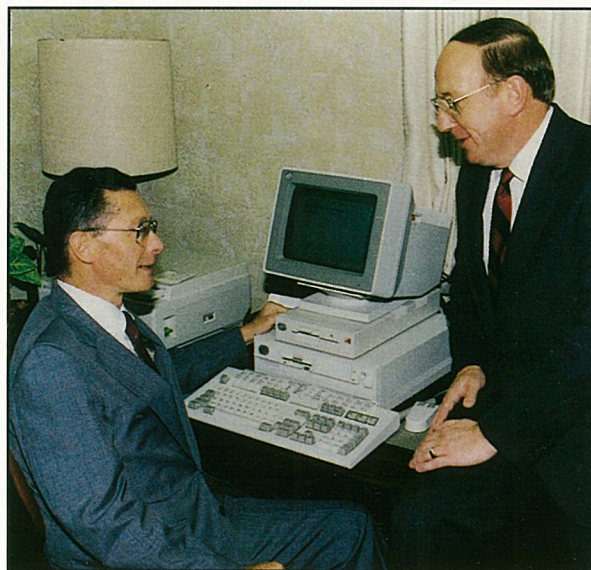
The top 100 were selected through data gathered in questionnaires and telephone surveys. Overall scores were based on information systems budget, company five-year profit average, current market value of major computer equipment, percentage of budget spent on staff, percentage of budget spent on training, and ratio of personal computers and terminals to total employees.

"The survey was more qualitative than scientific," said Asaph "Ace" Hall, corporate vice president and general manager of Data Systems Division, which provides the company's information systems services. "By no means are we perfect... we still need to improve on certain aspects of our activities."

The goals of Data Systems have changed over the last few years. "We have moved even more toward business orientation, having a direct relationship with the business of General Dynamics, as opposed to being as technology-driven as we may have been in the past," Hall said. "We are heavily into TQM... trying to compare how we are operating versus the best practices in the information systems field."

The division is also involved with quality-improvement projects at the company's other divisions. Getting information systems staff members included in a process improvement team at the outset has become an important requirement, according to Hall.

"People get very excited when they're empowered to go out and find better ways to do things," Hall said.



Ace Hall (left) and Larry Feuerstein of Data Systems Division

Data Systems' focus on running the division as a business rather than just a management information systems department has made a significant difference in effectiveness, according to Larry Feuerstein, Data Systems vice president-planning and quality assurance.

"We focus our attention on satisfying the business needs of the customer," he said. "In Data Systems' case, it's GD's other divisions that require and authorize our services. Our performance in satisfying the defined needs is part of the overall total quality management package."

It is difficult to compare the effectiveness of General Dynamics' information systems activities to that of other aerospace industry companies — except for surveys such as the *Computerworld* ratings system and specialized benchmarking studies, Feuerstein said.

"At this time when benchmarking is so popular, we consider this an indicator as to how we compare with the other aerospace industry firms," Feuerstein said. "We feel good about being named No. 1, especially when they describe the honor in terms of effectiveness. *Computerworld* is the leading publication in the information systems trade arena. They are very well-respected."

■ Myron Holtzman

News Briefs

Giving season at Fort Worth

Fort Worth Division got in the holiday spirit with two annual divisionwide projects for the needy.

The Adopt-A-Family program kicked off earlier than usual, and by mid-November over 100 departmental groups had signed up. Department members pool their resources to purchase food, clothes, toys and anything else needed to make the holidays brighter for families "adopted" by the departments. Past adoptions have provided such necessities as utility payments and auto repairs. Nearly 180 families were adopted in 1989.

Simultaneously with Adopt-A-Family, Fort Worth conducted its holiday season food drive in late November. The goal this year was a record 250,000 pounds of canned goods. A family-oriented fund-raising party to benefit the Food Bank of Greater Tarrant County kicked off the drive.

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Donation funds directory

General Dynamics has contributed \$30,000 to fund a directory for the Vocational Industrial Clubs of America. Directory data collected from businesses and the Vocational Industrial Clubs of America will be computerized to match occupations and company locations with club chapters and participating facilities.

The directory will instruct businesses and industry on working with schools' vocational training programs. Companies will be able to locate training programs near them that meet employment needs.

Vocational Industrial Clubs of America offers educational and industrial programs to vocational students in about 40 technical and trade areas. John Whiteside, director-equal opportunity employment and employee relations at Air Defense Systems Division, is former chairman of the clubs' Youth Development Foundation.

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Software gifts go to schools

Convair Division recently donated 232 WordPerfect word processing software packages to San Diego's city and county school districts. The gifts are part of a WordPerfect Corp. program that allows companies that upgrade software packages to donate old versions instead of destroying them.

o o o

Tuition to be tax-exempt

Thanks in part to a letter-writing campaign by employees, tuition reimbursement has been ruled tax-exempt.

Undergraduate courses will be non-taxable for the rest of 1990 and all of 1991. Graduate courses will be tax-exempt in 1991. Employees mailed more than 900 letters to Congress to request tax exemption.

o o o

Aviation hall honors Rogers

President and Chief Operating Officer Herbert F. Rogers has been inducted into the Aviation Hall of Fame in Fort Worth, Texas. Rogers has played a role in every major aircraft program at Fort Worth Division since 1949, the year he joined the company. Rogers has spent most of his career at Fort Worth.

o o o

Isbell steps up to 10th win

Fort Worth Division's Ron Isbell recently won the Reunion Tower stair-climbing race in Dallas for the 10th consecutive year. Isbell, a financial analyst, ran up the building's 835 steps in 4 minutes 8 seconds.

Entrants obtained pledges to benefit the Cystic Fibrosis Foundation. Isbell raised \$250. The race's 125 entrants generated a total of \$15,000.



Steve Antis and his wife, Jean, stroll through Old Town in their 1850s apparel.

Convair lab tester lives in the past

Steve Antis operates high-technology test equipment in Convair Division's vibration lab. But his heart is in the 19th century.

Once a month, he grabs his 1842 musket and heads for San Diego's Old Town State Historical Park, where he becomes a first sergeant in the U.S. Army, circa 1850. His company of infantrymen, dressed in the sky-blue uniforms of the Mexican-American War period, makes history come alive for visitors to the popular tourist destination.

"I become the character I'm portraying...I answer as a person of the 1850s."

— Steve Antis

Antis' lifelong interest in history led him to an organization called BOOT—Boosters Of Old Town. Members participate in living history activities at the park by re-enacting actual events in San Diego's colorful past. They portray people from all walks of life, from wealthy ranchers to important tradesmen to the soldiers who garrisoned the area. Careful research and attention to detail authenticate their clothing and accoutrements.

"Our group represents the 2nd Regiment, which was sent to San Diego in 1849 to handle incidents such as when Antonio Gara, a mission Indian, staged an uprising to protest a tax levied against Indians by the sheriff of San Diego," Antis said. "Some ruffians from San Francisco had come down to combat the uprising and the Army was called in to save the town from havoc."

The troops would have actually been mustered in the

town's center, now the site of Old Town. Today Old Town consists of many original and restored buildings located on the original sites they occupied in the period 1822-72. Old Town is one of the most heavily visited state parks in California.

"While we're in the park, I become the character I'm portraying so that when people come up to me, I answer as a person in the 1850s," Antis said. "People often ask to see inside my pack, so I try to keep authentic items in it like a spare shirt and socks, leather leggings, flint and steel for starting fires, the 'housewife,' which was a basic sewing kit, a tin plate and fork and usually a whiskey flask."

He tells the public that his pay as a first sergeant is \$12 a month, and the privates who serve under him earn the princely amount of \$7 a month. He describes the harsh conditions they live under and high desertion rates they suffer, not to mention illness and death. When the 2nd Regiment landed in California, they were close to full strength. Within two years a shipment of 250 men were sent to San Diego to replace losses from desertion.

As first sergeant of the company, Antis conducts drills and maneuvers in the park's public square, based on military practices of the period. He is often accompanied by his wife, Jean, who heads up the boosters' costume committee. Jean makes some uniforms and all of her own costumes.

"Unfortunately, many people don't know about the history of this area and sometimes when they see our light blue uniforms they'll ask, 'Are you Confederates?,'" Antis said. "It's frustrating, but that's why we are here. I believe that people need to be aware of and understand what we have been through to understand where we are now."

Once a year, Antis joins other history buffs in re-enacting the first American flag-raising in San Diego on July 29, 1846. Commodore Robert Stockton, commander of American troops in the Pacific, ordered a contingent of American sailors to go ashore and raise the flag during the Mexican/American War. For that re-enactment, Antis dresses as a sailor. The war ended in February 1848, and California became an American Territory.

This year Antis' company of 1850s infantrymen bivouacked at Seaport Village Park for San Diego's annual tribute to the military called Accolades. His unit was one of many portraying military units from all historical periods. They won first place in the Living History Contest's authentic cooking competition with their carne asada, tortillas and homemade salsa.

"There are many volunteer living history programs at parks and historic sites across the country," Antis said. "New volunteers are always welcomed. I would encourage anyone who is interested in history to seek them out and let them show you how to find a new place in time."

■ Julie Andrews

Sequel to company

As sequels go, Employee Photo Contest II developed into a smash hit.

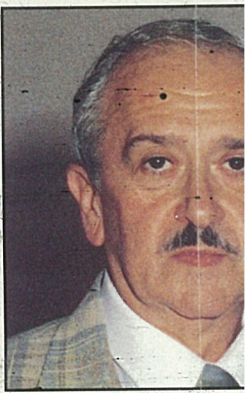
A total of 474 General Dynamics employees answered last summer's call for entries. Although that number fell short of 1989's, the quality soared. There were the usual quantities of sunsets, dogs and cats, but there were also unique subjects, artfully composed shots, and even a well-staged black-and-white effort that would have fit right in with a Calvin Klein ad campaign.

That made the judging hard yet enjoyable. The task required seven rounds of ballots before the five judges—Neal Chapman, Fort Worth Division photographer; Pete Connolly, corporate director-public affairs; Dave Lange, corporate manager-internal communications; Bruce McIntosh, corporate graphics administrator; and Dave Viens, Electric Boat supervisor-photo services—determined 12 winners and 36 runners-up.

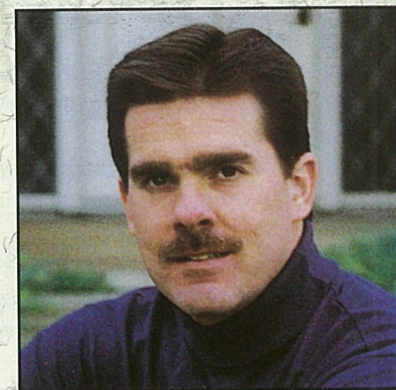
A double-barreled payoff awaited the chosen few. Each winner received a \$200 savings bond and each runner-up was given a \$100 bond. And the winning and runner-up photos have been printed in a 1991 calendar that is being distributed this month. The calendars also list the top 100 vote-getters. Calendars are available free



Linda S. Aguiar
Electric Boat Division



Frank Arnone
Land Systems Division



Charles E. Moritz III
Fort Worth Division



Patricia A. Morris
Air Defense Systems Division

Christmas angels San Diego employees make need

People grumble about Christmas decorations that appear in the stores before the frost is on the pumpkin. But it is never too early to start planning holiday projects that help the less fortunate.

General Dynamics' San Diego employees began gearing up in October to support the Angel Tree program. The county-sponsored project makes holiday dreams come true for thousands of abused and neglected foster children.

Children who are being supervised by the San Diego Department of Social Services make tree decorations in the form of teddy bears. Each tag lists the maker's first name, sex, age and wish for a Christmas gift.

Space Systems, Convair, Electronics and Data Systems-Western Center are receiving 500 tags to decorate various trees around company facilities. Employees or departments can pick tags off the trees and purchase the wished-for items.

Barb Oliver, Space Systems chief-voice data services, heads the multidivision Angel Tree committee. She has seen the

Savings and stock investment plans

	Annual rate of return for the 12-month period ending:		
	Oct. 1988	Oct. 1989	Oct. 1990
Salaried			
Government bonds	7.7%	9.1%	8.5%
Diversified portfolio	13.2%	29.5%	(11.0)%
Fixed income	10.8%	10.4%	10.1%
Hourly			
Government bonds	7.9%	9.3%	8.5%
Diversified portfolio	13.3%	30.3%	(11.1)%
Fixed income	10.7%	10.4%	10.1%
GD stock closing price	\$53.50	\$52.50	\$23.87
() Denotes negative number			

Company's employee photo contest attracts 474 entries

of charge at public affairs offices.

The Employee Photo Contest has been especially profitable for Fort Worth's Dennis Overturf and Land Systems' Frank Arnone. Overturf is a repeat winner from last year. Arnone, another of 1990's 12 winners, took a runner-up prize in 1989.

A 23-year employee who is an engineering specialist at Fort Worth, Overturf says, "My specialties are landscapes and special events." He won in each, receiving a top award last year for a photo of a balloon race and this year with a shot of an unusual spillway water pattern.

Arnone is a 37-year employee and winner of numerous photo awards since first picking up a camera in the late 1940s. While vacationing in New Mexico, he spotted a wagon wheel embedded in the ground. "I couldn't pass this up, so I took one shot," he says. That one shot was a winner.

Other winners told similar tales. Hien Q. Pham of Fort Worth had set up a long-exposure shot of the Washington Monument framed by

the walls of the Lincoln Memorial. "I was looking through the viewfinder thinking something was still missing ... then miraculously a man and his son stepped in and stood there talking," he says. "I carefully tripped the shutter to capture the rare moment, which lasted less than 15 seconds."

Another Washington landmark provided the winning backdrop for Valerie Paveléc, who works at Data Systems' Financial Services Center in Temecula, Calif. She trained her camera on the Vietnam Veterans Memorial. "The sensation the memorial gave to me was reflected in the crowd - sadness, reverence and curiosity," she says. "In taking the photo I was hoping that the reflections of these emotions would show." They did.

Fort Worth's Chuck Moritz hankers for action photography. He had to work hard to capture busy Buster, an oft-airborne Yorkshire terrier. "Given Buster's energy level and small size, several attempts were necessary to capture him 'in-flight,'" Moritz says.

Another Fort Worth employee, Mike Moon, likes to

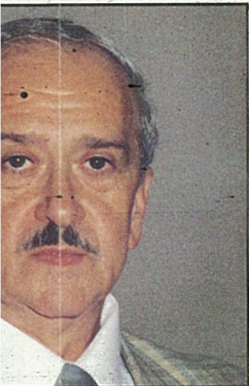
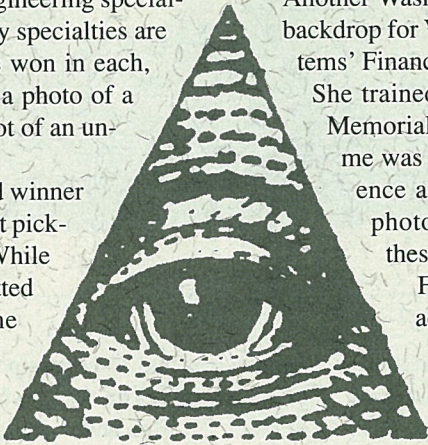
put together ballooning with photography - a winning combination for Photo Contest II.

The winners included near-pros such as Space Systems' Michele Labre, whose father is a professional photographer; specialists such as Convair's Fred Morghen, who prefers shooting with a small and highly portable 35mm Olympus XA3; self-trained shutter bugs such as Fort Worth's Onis Cox, who has been snapping away since his Army days but has never had formal instruction; and newcomers to the hobby such as Electric Boat's Linda Aguiar, who has been interested in photography for less than two years.

Two entrants adopted tried-and-true subject matter: little people. "The winning photograph is this grandma's pride, since it's my first grandchild, Melissa McMillan, enjoying the California poppies in my front yard," says Jan Wilder of Air Defense Systems-Pomona. Pat Morris of Air Defense Systems-Valley positioned her baby grandson, Travis, in a mass of pumpkins. "I knew my grandson's little bald head would do it for me," she says.

She was right.

(Pictured below are the 12 winners of Employee Photo Contest II.)



Onis L. Cox
Fort Worth Division



Michele Labre
Space Systems Division



Michael Moon
Fort Worth Division



Fred A. Morghen
Convair Division



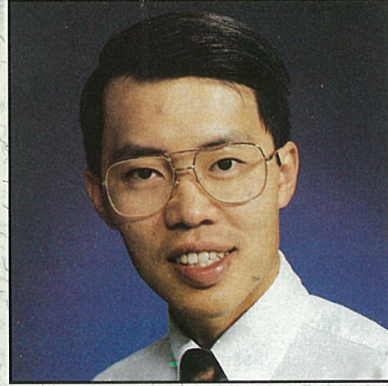
Pat Morris
Systems Division



Dennis B. Overturf
Fort Worth Division



Valerie Paveléc
Data Systems Division



Hien Q. Pham
Fort Worth Division



Janet E. Wilder
Air Defense Systems Division

Angels needy children's wishes come true

project grow rapidly in her three years with the Angel Tree project.

"Three years ago, we passed an empty breadbasket at our department Christmas lunch to collect money for needy kids," Oliver said. "We got some names from the Department of Social Services of teen-agers who wanted a pair of jeans or high-top shoes-things we think are ordinary but mean a lot to them."

Oliver's department continued the project last year. Other departments wanted to join. This year, so many groups called that it was decided to make it a divisionwide project. That snowballed into an all-San Diego-division effort.

Oliver tells the story of last year's one remaining tag with its wish for a Los Angeles Raiders football jacket. Only \$20 remained from collected cash - not enough for the expensive item, whose black-and-gray skull emblem can make a San Diego Chargers fan see red. The next morning, an anonymous Santa had left the coveted jacket in Oliver's office.

Now that's the Christmas spirit.

■ Julie Andrews



San Diego employees who coordinate the Angel Tree project pose with teddy bears.

Abrams tank gets four-star review

Land Systems Division's M1A1 Abrams tank performed flawlessly during a grueling monthlong demonstration of mobility, firepower, durability and maintainability in the United Arab Emirates.

The Abrams covered a 1,568-kilometer course, which included "some of the worst heat, finest sand and highest dunes on Earth," according to a U.S. Army Tank-Automotive Command statement. The M2/3 Bradley Fighting Vehicle also participated in the demonstration for potential purchase by the United Arab Emirates.

The United Arab Emirates is an oil-rich federation of what were once seven Arab sheikdoms. It covers some 32,000 square miles, is located on the Arabian Sea and is bordered by Saudi Arabia to the west and Oman and the Gulf of Oman to the east. The population numbers less than 200,000.

The demonstration included hands-on use of the Abrams and Bradley by highly experienced United Arab Emirates military personnel who have also driven and fired British Challenger, French AMX 40 and Soviet T-72 tanks.

James Biermann, manager-international marketing, and William "Pat" Pietrangelo, systems engineer, served as Land Systems' on-site representatives.

"A very important portion of the tests, one which indicates how well the Abrams/Bradley team can be expected to operate in the desert, truly impressed the United Arab Emirates officials," said Lt. Col. Robert Daniels, Army program executive officer who headed the American test contingent of 25 soldiers and civilians. "First, the United Arab Emirates required that equipment be tested during the summer. And it had to be tested under the most arduous circumstances.

"Starting with fully fueled vehicles, United Arab Emirates crews tested operating range by driving across rough terrain at the maximum speed the crews could stand. At cross-country speeds of up to 40 mph, in slightly more than six hours, the Abrams covered 335 kilometers and the Bradley 310 kilometers before running out of fuel."

The Abrams then demonstrated perfect marksmanship on the firepower test course. Crewed by U.S. Army personnel, the tank fired one test round to "zero" its 120mm main gun, then squeezed off 21 for 21 daytime center-of-mass hits at ranges of up to 2,900 meters. This included moving tank vs. moving target engagements at 1,600 meters. The target was half the normal NATO-approved target size, a Soviet BMP armored personnel carrier.

Nighttime firing didn't bother the Abrams' accuracy; the tank scored 17 of 17 dead-center kills.

"The vehicles came through with flying colors as far as maintenance was concerned," Daniels said. "We took extremely few spare parts along with us and we never had to call out for help. Fact is, we had zero mission failure incidents during the entire event.



The M1A1 Abrams tank impressed evaluators in the United Arab Emirates.

"The United Arab Emirates officials who observed the tests—including Sheik Mohammad Bin Zayed Al Nayhan, who is deputy chief of staff-armed forces, and Brig. Gen. Saif Sultan, who heads the tank selection team, indicated they were highly impressed with the Abrams/Bradley armor team. In fact, a United Arab Emirates air force team was called in to examine the Abrams turbine engine and they were literally astounded at its reliability and performance in the desert. They were also impressed with the ease of maintenance."

Planning for the demonstration was done on short notice. Plans began in June for an August demonstration;

however, it had to be postponed because of Operation Desert Shield. The demonstration was again approved on Sept. 21. Men and materiel were in place on Sept. 27 and the demo was completed by Oct. 26.

The successful demonstration marks the fifth time these particular Abrams tanks have been demonstrated to potential allied buyers—Saudi Arabia and Egypt in 1987, Pakistan in 1988 and Sweden in 1990. "They have been through the worst deserts and heat in the world, the arctic and back and they keep on running," Daniels said. "I believe the type of exposure buyers get in these demonstrations convinces them we've got the best to offer."

Sterling performance earns Army honor

The Army's Tank-Automotive Command has certified Land Systems Division's Sterling Manufacturing Plant under the government's Contractor Performance Certification program.

The program recognizes contractors who consistently deliver quality products, control their processes, employ aggressive audit procedures and demonstrate continuous improvement.

Certification reduces the government's in-plant quality assurance involvement in day-to-day activities, thus lowering costs to taxpayers while maintaining the highest quality. The Abrams tank is the first combat vehicle to be included in the program.

The Sterling Manufacturing Plant in Warren, Mich., assembles hull and turret network boxes for the tank.

"We trust you more, inspect you less, and have more confidence in your product," said Maj. Gen. Leo J. Pigaty, commander-Tank-Automotive Command during

a ceremony at the plant.

The certification marked early completion of the 12-month program. The company met rigid quality standards that emphasize defense contractors' responsibility to assure product quality before government delivery.

All four Land Systems manufacturing facilities are either certified or enrolled in the Army's program. The Detroit Arsenal Tank Plant in Warren, Mich., one of the two plants where the Abrams is assembled and where machining operations are performed, achieved certification last January. The Scranton Plant in Eynon, Pa., where the division machines turret and hull race rings and other assembly components, began the 12-month certification process last April. The Lima Army Tank Plant in Lima, Ohio, where the Abrams is also assembled and where all tank hulls and turrets are fabricated, began the process last June.

■ Karl G. Oskoian

TQM CASE STUDIES

Space Systems launches mission to halve engine delivery time

A Space Systems Division and Pratt & Whitney total quality management team has hammered out a process improvement plan to halve the delivery time of RL-10 engines by the end of the year.

Pratt & Whitney has been making the RL-10 engines for Space Systems' Centaur upper-stage launch vehicle since 1963. The current backlog of 144 engines is the largest in the program's history.

"We have just wrapped up about a nine-month effort since joining with Pratt & Whitney last January to improve the acceptance process for the Centaur engines," said Joe Cimenski, a Space Systems member of the team who works in the Titan/Centaur program office. "We will now start to monitor the permanent changes we have made to measure the process improvements."

The team was established last January after a meeting in late 1989 between John Balaguer, executive vice president of Pratt & Whitney, and Alan Lovelace, Space Systems general manager.

"Customers and suppliers working together to im-

prove performance is one of the basic philosophies of total quality management," said Balaguer. "Neither the customer nor the supplier was satisfied with the acceptance process for the RL-10."

It takes up to 110 days from the completion of engine acceptance tests until the engine is delivered to Space Systems. Although a reduction in engine sell-off time was the primary goal, the team had other objectives, including a reduced price for Space Systems and streamlined inspection and approval requirements for Pratt & Whitney.

Team members meet about once a month, usually in conjunction with other trips, since Pratt & Whitney is in Florida and Space Systems is in San Diego. Other members of the team include the Air Force plant representative at Pratt & Whitney and Pratt & Whitney's "Q+" facilitators. Pratt & Whitney initially trained the team.

The team formally started its process improvement plan in September and is measuring the results. The team has already noted many improvements:

- Over 25 Space Systems operations eliminated;
- Core membership of hardware acceptance team reduced by 50 percent;
- Travel costs per engine for Space Systems reduced to \$3,000 from \$10,000 and travel hours per engine cut to 10 from 27;
- Reduced documentation and transportation of the engine during sell-off.

The team is trying to cut the sell-off process to 20 days from a high of 110 and an average of 65. The team expects to be at 32 days by the end of the year.

"It's not an easy fix," Cimenski said. "It's best described as continuous improvement. The TQM approach is not a Band-Aid approach. I was uncomfortable at first with the idea of taking nine months to implement a change, but now I'm really sold. We have a much better process in place and there is more emphasis on teaming. Once you get people to buy into the process, they have ownership and it really makes a difference."

■ Julie Andrews

Experts pitch quality at Land Systems

Land Systems officials recently learned the latest in quality manufacturing methods when two international experts visited the division.

Stuart Pugh, Babcock professor of engineering design at the University of Strathclyde in Glasgow, Scotland, discussed concurrent engineering principles. Shin Taguchi, son of Japanese quality guru Genichi Taguchi, glowingly reviewed the division's application of his father's methods.

Pugh's two-day presentation highlighted Land Systems' celebration of National Quality Month in October. Taguchi visited shortly before National Quality Month.

Pugh concentrated on determining if a product design has reached its fullest potential and, if not, how to get there.

"Professor Pugh's insight on how to converge on the best design will play a key role in improving our concurrent engineering effort," said N.S. Sridharan, director-structures and design and host for Pugh's visit. "The result will be improved product performance, higher quality and reduced cost of development."

Taguchi, whose father developed quality engineering tools used throughout the world, complimented Land Systems employees at the Detroit Arsenal Tank Plant for "having one of the best commitments to quality I've seen in the United States."

He made his comments after observing the plant, statistical process control charts and the action-team approach to identify and resolve problems. Taguchi methods are commonly used in Japan to obtain the best product and are rapidly gaining acceptance in the United States.

"We found that we are doing a good job when compared to other users of the Taguchi methods," said Fred Ade, Land Systems liaison engineering. "But we are most proud of Shin's observation on our commitment to quality."

Land Systems marked its quality commitment with numerous activities during National Quality Month. This year's National Quality Month theme was "The Human Side of Quality: People, Pride, Performance." Land Systems adopted its own theme, "Extraordinary People Doing Extraordinary Things."

Land Systems started its National Quality Month activities with ceremonies at the Central Office Complex. Major Land Systems suppliers, customer representatives from the Army program office and the Army Tank-Automotive Command, and 2,000 Land Systems employees attended.

Monthlong quality activities included seminars, luncheon presentations and videos. Information centers at each facility distributed literature and promotional items. Special recognition certificates were given to employees. Winners of a quality quiz/drawing received \$100 savings bonds.

"We view the Quality Month activities as a success because they have made all of us more aware of the need to keep quality foremost in our everyday efforts," said Earl Mustonen, Land Systems director-quality programs. "Plans are already under way for participation in the 1991 National Quality Month campaign."

■ Jack Price

Electronics beats B-2 delivery deadline by month

Beating the contract schedule by 31 days, Electronics Division delivered the first Flight Avionics Consolidated Test System to Northrop Corp. on Nov. 6.

The equipment will be used by Air Force personnel to automatically test the electronics and avionic systems of the B-2 stealth bomber. The first stations will develop the test program for the airborne systems.

A ceremony attended by Northrop officials and Electronics employees marked the delivery.

"We are proud to be on the team contributing to the most advanced strategic aircraft in the world," said Walt Robertson, Electronics vice president-automatic test systems. He presented a certificate signifying final acceptance testing of the system to Oliver Boileau, Northrop president-B-2 Division and former General Dynamics president.

Lew Israelitt, Northrop vice president-integrated lo-

gistic support, presented Electronics with an Award of Excellence as an outstanding supplier. Only a dozen such awards have been made to a supplier base of over 3,000.

The delivery continues a long string of Electronics factory deliveries made on or ahead of schedule.

"Since January 1989 our factory has delivered over 12,000 contractual items, all ahead of schedule," Robertson said. "Only three of those items were less than 30 days ahead of schedule."

Electronics was awarded a \$26 million contract in October 1988 to build the automatic test stations for the B-2 program. The contract calls for Electronics to build 10 development test stations, all to be delivered to Northrop by early next year. A production option may be exercised by Northrop for additional stations.

■ Julie Andrews



Brent Fischmann of the Defense Initiatives Organization helps Fran Newkirk (left) and Lucresha Murphy.

Kids learn computer literacy from DIO 'weekend warriors'

What kid would give up part of a weekend to go to class? Kids who attend a free computer education class given by General Dynamics' Defense Initiatives Organization, that's who.

Junior high school students from the Washington, D.C., area receive instruction from Defense Initiatives volunteers in Rosslyn, Va. One student wanted to attend so badly when his family was out of town that he stayed overnight with neighbors and caught a train after class to rejoin his family, according to one of his teachers.

General Dynamics employees wanted to help educate youths who might otherwise not be exposed to modern computers and the high-technology American workplace. The Defense Initiatives Organization arranged the program earlier this year with George Washington Junior High School through the help of George Washington University's School of Education and Human Development.

The program is entirely the result of voluntary efforts and costs the local school district and General Dynamics nothing. Volunteer teachers drive students to and from General Dynamics offices and help supervise the classes. Company volunteers give hands-on individual instruction on Defense Initiatives computers.

Employees volunteer on Saturday mornings to instruct students on Macintosh SE and SE/30 computers. More than a half-dozen computers are linked in a local network for instructions to groups and individual students. Overhead display equipment is connected to a Macintosh II color computer for on-line, step-by-step demonstrations.

Word processing and graphics programs are taught so that seventh graders can work on articles for their school newspaper. Students print the results of their computer efforts on a laser printer to take home and to school.

Air Force honors blue-ribbon service

Fort Worth Division has been approved as an Air Force "blue-ribbon contractor" for 198 parts the service orders as F-16 spares.

The Ogden (Utah) Air Logistics Center added General Dynamics to its blue-ribbon list based on delivering quality products on schedule at reasonable costs. The schedule criterion is that deliveries for a given parts class must have been on time for at least 90 percent of the past year.

Blue-ribbon contractors are approved to receive spares orders even when their prices are higher than other bidders because they are perceived to offer greater overall value to the government. Before the Air Force Logistics Command's blue-ribbon initiative, spares contracts were awarded primarily to the lowest bidder.

About 30 percent of the companies that apply for blue-ribbon status have met all the criteria.

The division's performance will be reviewed every six months to continue blue-ribbon listing.



Avoid Christmas burnout. Santa reminds us that fire hazards during the holiday season, such as overuse of extension cords, can cause shocking experiences. Other unsafe practices shown include an open fireplace and stockings and gifts too close to the fire. (Santa is played by Mike Munson of Convair Division's photo department for an in-house fire prevention poster.)

TIM WHITEHOUSE

Pace bows out

Time to 'go way back and sit down'

After Jan. 1, Stan Pace's biggest challenge won't be to turn a profit for General Dynamics or read a lot of reports.

Instead, he'll be reading Gibbon, Toynbee and golf greens.

Pace, the company's chairman and chief executive officer since Dec. 31, 1985, is retiring at the end of the year.

"I'm 69 years of age and I've been in the trenches an awfully long time," Pace says. "What I intend to do, at least initially, is go way back and sit down."

Pace and his wife, Elaine, have built a home in the Palm Springs, Calif., area. There, in the heart of golf country, Pace will pursue his passion for reading about ancient civilizations when he's not on a golf course.

Recent history also interests Pace, but for another reason: When he reads about that subject, he relives it.

Pace has participated in the two major events of the last 50 years: World War II, in which he flew B-24s during the strategic bombing campaign over Europe; and the Cold War, in which he helped lead the defense industry that equipped the United States and its allies.

Pace also figures prominently in the history of General Dynamics. The company lured him away from impending retirement after 30 years with TRW, Inc., to lead General Dynamics through one of its most trying times.

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In the mid-1980s accusations of wrongdoings were made against the company. Pace, whom friends call absolutely honest and whom reporters call "Mr. Clean," accepted General Dynamics' offer to become vice chairman on June 1, 1985, and chairman and chief executive officer at the end of the year.

At the time, a TRW spokesman described Pace as "an extremely analytical person who quickly sizes up a problem and cuts right through to the core in a hurry." Pace's analysis of General Dynamics led him to come aboard with five objectives:

- Preserving the company's technical and business leadership;
- Expanding the company's military space and electronics markets;
- Restoring the company's image;
- Determining whether or not to diversify commercially;
- And creating a management succession plan.

All five objectives were reached by the end of 1989:

- General Dynamics is teaming with other companies on cutting-edge programs such as the A-12 Advanced Tactical Aircraft, the Advanced Tactical Fighter and the National Aero-Space Plane. The company was awarded production of the first *Seawolf* attack submarine.
- General Dynamics has secured commitments to launch 36 military and commercial payloads into space and was named to produce the Army's Single Channel Ground and Airborne Radio System.
- The company put in place comprehensive ethics and ombudsman programs; in 1987, then-Secretary of the Navy John Lehman Jr. said, "There is no better relationship between the Navy and a contractor."
- Management opted not to diversify after finding that defense companies' commercial ventures have failed overwhelmingly.
- In September 1989 William Anders was named to succeed Pace.

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Pace has applied his leadership skills to both the defense industry and the community. He has testified for the industry before Congress, has been chairman of the National Association of Manufacturers and is chairman of the Aerospace Industries Association Board of Governors.

He received two industry honors this year: the Forrester Award from the National Security Industrial Association for maintaining close and continuous working relationships between the government and industry in the interests of national security; and the Nimitz Award from the Navy League for contributions to the nation's maritime strength and security.

"Stan has made a great contribution to the industry in the area of ethics by urging industry to be more ethically

community, but he did more than his share for Cleveland at a very difficult time for the city," says Art Modell, owner of the Cleveland Browns and a friend of Pace's.

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Pace was born in 1921 to a middle-class farming family in the Kentucky hills about 10 miles north of the Tennessee border. He won appointment to the U.S. Military Academy, spent a year preparing for West Point at the University of Kentucky, and graduated 20th out of 514 cadets in 1943. He was shot down in his B-24 on his 39th mission and suffered burns. He spent the rest of the war as a German prisoner. He rose to colonel before leaving the Air Force for TRW in 1954. He worked his way up to the No. 2 position at TRW and was ready to retire when the top job at General Dynamics beckoned.

His career resulted from hard work and good luck, Pace says. "You must be prepared and stand by the front door," he says. "If you are prepared and the door opens, you can go in. My mother had a saying: 'Son, if you do your best, angels can do no more.'"

West Point and World War II molded Pace.

West Point instilled in Pace an appreciation for academics, discipline, responsibility and patriotism. Bernard Rogers, a member of General Dynamics' Board of Directors, a retired Army four-star general and one of Pace's West Point classmates, recalls: "We were in K Company together as plebes. We marched together, ate together and lived together. He impressed me as bright, energetic and very honorable. It was pretty tough, but he's a Kentuckian with a sense of humor, so he was always able to take all the tough times."

The inscription under Pace's photo in the 1943 edition of the *Howitzer*, the West Point yearbook, reads: "Stan was a Kentuckian through and through. He fought hard for everything he thought was right, and it usually was. Stan was a natural engineer with all the ability a man could ask for. He was conscientious about everything he partook in, even in his stories about the feuds back

home. He will long be remembered as an old English hive. [Cadetese for someone who is very bright.]"

Rogers, Pace and other cadets went to a movie one Sunday afternoon in December 1941. They emerged from the theater to discover the United States was at war.

The class of 1943 was supposed to be the class of '44. But well-trained men were needed in a hurry. Pace's class was sent through West Point in three years and went into combat after additional training. The class suffered 33.9 percent casualties. By the war's end, 57 of Pace's classmates had been killed in action, 11 had died from other causes and 105 had been wounded.

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As retirement nears, Pace anxiously awaits time that is all his own. "I'm looking forward to doing what I want to do, not what I have to do," he says. He will remain a member of the boards of directors at General Dynamics and Pittsburgh-based Consolidated Natural Gas Co.

Pace leaves as chairman with a last message to General Dynamics employees:

"You're a great team. I've been very pleased to have been part of this team.

"There's great concern about the reductions upcoming in the defense industry. But although the defense industry will be smaller, we will still be handling the most advanced technology in the world and nothing could be more exciting or rewarding than to be right on the leading edge of technology.

"I encourage everybody to hang in there through the difficult times because, even though smaller, General Dynamics can be just as great and hopefully even greater than it has been in the past."

■ Dave Lange



FILE PHOTO

"I encourage everybody to hang in there. ... General Dynamics can be just as great and hopefully even greater than it has been in the past."

— Stan Pace

responsible," said Don Fuqua, president of the Aerospace Industries Association. "He has become an industry spokesperson on this issue and has made General Dynamics a role model for all of corporate America.

"Stan also served as chairman of the Board of Governors ad hoc committee on material management accounting systems. He was personally responsible in leading the industry to improve their systems and his efforts were instrumental in steering off restrictive legislation."

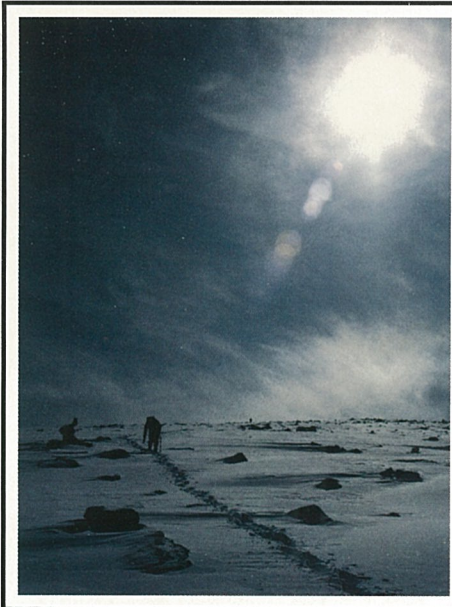
Numerous community activities have attracted Pace's attention. In St. Louis, where General Dynamics is headquartered, Pace has been instrumental in restructuring the local Community Foundation, which this year established a fund in his name. General Dynamics' corporatewide contributions program started after Pace joined the company.

Pace established himself as a civic leader in Cleveland, TRW's base, by heading United Way drives, the Greater Cleveland Roundtable and the Cleveland Community Foundation. "A lot of CEOs are active in the



HONORABLE MENTION
Carole Black
Convair Division

▲
FIRST PLACE
Jim Nugent
Space Systems Division
Using his Pentax ME (f2.8 at 1/60th of a second), Jim Nugent, QA Group Engineer at Space Systems, caught this introductory meeting in San Diego between 84-year young Mildred Alexander and Mark Graham, Jim's three-month old grandson from Vancouver, B.C. Film: Kodak Gold ASA 200 pushed to 400.



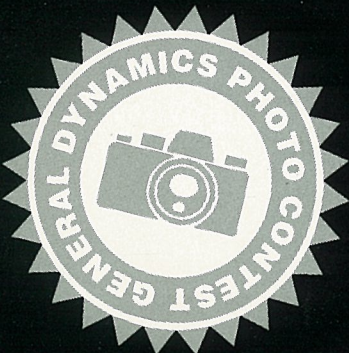
HONORABLE MENTION
Kevin Keierleber
Space Systems Division



HONORABLE MENTION
Howard Spring
Freeman United Coal Mining Company

JANUARY 1990

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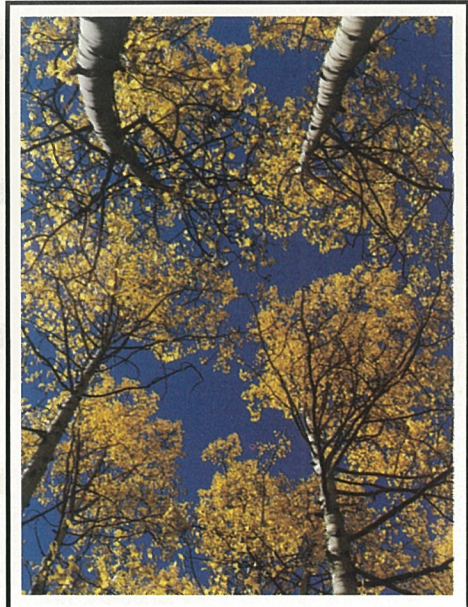


HONORABLE MENTION
Mai Quan Vinh
Space Systems Division



HONORABLE MENTION
Lance H. Carter
Space Systems Division

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FIRST PLACE
Michael R. Underwood
Convair Division
Shooting from a helicopter, Convair senior engineering planner Michael R. Underwood used a Nikkormat FT with 85-210 zoom lens to capture this dramatic late afternoon shot of the Na Pali coast, Kauai (Hawaii's "Garden Island"). Mike used Kodachrome 64 film and f22 shutter stop at 1/500th of a second.



HONORABLE MENTION
Mark A. Hoban
Fort Worth Division

FEBRUARY 1990



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